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A Study of the Intervertebral Disc:

With Special Reference to Rupture of the Nucleus Pulposus and Its Relation to Low Back Pain and to Sciatica

Leland L. Swenson, M. D.

Low back pain and sciatica have constituted one of the clinical bugbears of the average practitioner as well as the orthopedic surgeon. Some of them almost shuddered when told that such a patient was waiting to see them. Some would refer them to others. Some would wish that the patient might go to an osteopath, even a chiropractor! Conscientious orthopedic and neurological surgeons would attempt to differentiate between the causes for pain in the back and lower extremities. Some of these causes were recognized promptly and adequate treatment administered, whether corrective, manipulative or operative. Some of the causes belong in the field of internal medicine and may be due to diabetes, vascular disorders or to various intoxications, as from arsenic, lead or alcohol.

Other cases are frankly neurologic in origin and are due to intraspinal or extradural neoplasms or metastatic lesions in the spinal column.

When these conditions are recognized and excluded there yet remains a large group of patients who do not respond satisfactorily to the conservative measures of bed rest and physical therapy. This group should be studied with special attention directed to both the gait and the ability of the patient to move his spinal column. Roentgenograms of the spinal column and pelvis should be made since intraspinal lesions of the thoracic portion of the spinal column can, and not infrequently do, result in low back pain with or without sciatic involvement.

Spinal fluid should be obtained, studying not only the cell count and total protein but also the hydrodynamics to determine a block of the spinal subarachnoid space above the insertion of the needle.

In the presence of lesions compressing the cauda equina, the epidural injection of a solution of procaine hydrochloride through the sacral hiatus will result in severe exaggeration or reproduction of the patient's pain.

Many new types of treatment have been introduced in the past for the treatment of sciatica: rest in bed; immobilization in plaster or in splints; manipulation of the spine and sacro-iliac joints; stretching of the sciatic nerve; epidural injections, and injections of saline, etc., into the nerve. Many cases recover unaided, but recurrent attacks are not uncommon and sciatica may become a chronic, disabling affection.

Physicians have been too prone to reason from inference rather than from a study of the actual anatomy and physiology of the structures responsible. Sciatica was often vaguely referred to by these men as a neuritis or a radiculitis. Orthopedic surgeons looked to structural abnormalities of the lumbar spine and sacro-iliac joints, until Middleton and Teacher called attention to the possibility of nerve compression by herniation of nuclear material. Their patient, while

Blodgett Memorial Hospital, Grand Rapids, Michigan.

lifting a heavy object, heard a "crack" in his back and suffered severe pain in the lumbar region which was followed by a paraplegia. Sixteen days later the patient died; at autopsy, hemorrhage and softening of the lumbar enlargement were found to be due to a herniated mass of pulp from the intervertebral disc between T12 and L1.

The above authors carried out experimental observations on cadavers to study the effect of trauma. By pressure with a vise they were able to force nuclear material through the inner layers of the annulus. This was accompanied by bulging of the disc close beside the posterior longitudinal ligament.

Other men began to find "chondromata," etc., —"tumors" of the intervertebral disc—causing compression of nerve roots and cords, until Dandy in discussing two cases, stated that the lesions undoubtedly were of traumatic origin, not neoplastic.

Pathologically, posterior herniations of the nucleus pulposus have been recognized by Schmorl, Andrae, and others, but the true clinical importance and relationship of the intervertebral disc to sciatica was the product of American workers, particularly Barr and Mixter, who, in 1934, reported 19 cases in which they established the histologic structure as being that of some element of the intervertebral disc—nucleus pulposus, annulus fibrosus, or both. They also emphasized the presence in some of these cases of findings indistinguishable from lumbosacral or sacro-iliac strain—namely, painful, rigid back; "sciatic" radiation of pain; limitation of straight-leg raising; sciatic scoliosis, and others.

Ayer and Mixter added 15 more cases in 1935 in which the entity had become so well recognized that the differential diagnosis lay, not between a true spinal tumor and rupture of the disc, but between rupture of the disc and an orthopedic condition. Since that time hundreds of cases have been reported from the large clinics.

With these preliminary remarks the subject of rupture of the nucleus pulposus will be reviewed with initial reference to the basic sciences of anatomy, physiology and pathology, followed by diagnosis and treatment.

ANATOMY

The interval between two adjacent vertebral bodies is occupied by the intervertebral disc composed of two cartilage plates with the nucleus pulposus sandwiched in-between and the whole disc bound circumferentially by the annulus into which both cartilage and nucleus blend.

The intervertebral discs constitute as much as one-fourth of the total length of the presacral portion of the spinal column. The inequalities in their anterior and posterior aspects are in large measure responsible for the characteristic curves of the cervical, thoracic and lumbar regions. In consequence, pathological conditions involving the discs frequently are expressed in modifications of the normal curves.

These discs are subject to continuous and progressive changes of structure throughout life, which is divided into two stages: the first, extending from fetal life to approximately the third decade, is characterized by an increasing turgor and elasticity of the nucleus, together with the crystallization of the fibers of the annulus in response to functional stress and strain. The second stage, from middle age on, is distinguished by progressive dehydration of the disc.

The cartilage plates may participate in the progress of degeneration either by proliferation or by desiccation, or by the development of fissures and cracks with prolapses of the disc tissue into the spongiosa.

PHYSIOLOGY

The intervertebral disc permits movement between the series of vertebral segments and is related to the transmission of body weight, to the absorption and dispersal of the multitudinous shocks to which the column is constantly exposed and to the maintenance of the normal spinal curves.

The elastic turgor of the disc exerts an expanding force on the opposed vertebral bodies. This force is resisted by the various spinal ligaments, establishing a state of internal equilibrium. When deformity has occurred these forces tend to restore the column to the status quo. This expanding force approximates in the individual discs of the lumbar region some 30 pounds in fresh cadavers. It is estimated that in the living, erect subject, the superincumbent weight of the trunk and upper extremities must raise this pressure to well over 100 pounds. During spinal movements, as when the back is extended from the flexed position, it may be in excess of 200 or 300 pounds. The ability of the disc to withstand such high pressures is related to its high water content which is 80 per cent in the nucleus and 78 per cent in the annulus at birth. These percentages slowly decrease during the first five decades after which rapid loss occurs in the nucleus accompanied by various degenerative changes. Pascal's law that liquids transmit in all

directions and without diminution any pressure applied to them and may for all practical purposes be considered as incompressible, thus explains part of the above, according to Petter.

Daily variations in water content are suggested by the observations of dePuky who, in measuring 1200 persons between the ages of 5 and 90, found a daily oscillation in their total heights averaging 1 cm. in females and 2 cm. in males; the younger the person, the greater the fluctuation; being taller on arising, the individual decreases in stature during the course of the day.

Movement occurs by change in shape; that is, in flexion, there is compression of the disc anteriorly and expansion posteriorly. During extension there is anterior elongation and posterior compression. Should extension continue to the point where the spinous processes contact one another, this point of contact becomes the fulcrum and further extension leads to elongation of the entire disc with narrowing of its diameter. These movements are of considerable importance in the production of the various types of anterior and posterior fissuring of the annulus, in the pathologic displacements of the nucleus and in the deformities of the spine, such as scolioses, which attend disc degeneration.

DEVELOPMENT AND MALFORMATION

The intervertebral discs have origin in part from the remnants of the primitive notochord and in part from the mesoderm between successive blocks of rapidly chondrifying tissue which establish true vertebral segments. The disc is vascularized during the fetal period but undergoes progressive postnatal regression and atrophy, leaving behind scars and defects in the cartilage plates. Such defects predispose to fissuring of the plate and escape of nuclear material. There also may be the persistence of a portion of the notochord passing through the center of the vertebral body allowing the hernias seen in juvenile kyphosis. Persistence over several segments is most common in the thoracic region and usually is associated with malformation of the vertebral bodies and some degree of kyphosis. Gross malformation of the discs is associated with such congenital anomalies of the spine as spina bifida anterior, hemivertebrae and the Klippel-Feil syndrome. Complete absence of the disc has been observed, giving rise to what Schmorl and Junghanns pointed out as "Blockwirbel" in which small disc remnants often were found.

PATHOLOGY

As mentioned above, the discs undergo progressive changes with degeneration as the ultimate outcome. Trauma is recognized as a factor in this process. In compression fractures, the bones often are damaged the most and the discs the least. The cartilage plates may be damaged or fractured leading to massive herniation of the nucleus into the spongiosa; there may be little damage to the spongiosa with the establishment of Schmorl's "Knorpelknoetchen"; the spongiosa may collapse without damage to the cartilage plate which is followed by expansion of the nucleus and the formation of an amphicelous or fish-like vertebra, "Fischwirbelbildung."

The annular part of the disc may be crushed in front or at the sides; in these instances the center may later undergo bony fusion with partial obliteration of the disc. The annulus may be perforated with loss of nuclear substance and eventual degeneration, such as is seen in traumatic dislocation of the spine or even by spinal puncture, five cases of which have been reported by Milward and Grout. In these cases patients suffered from pain in the back and legs after spinal anesthesia and were shown to have narrowing of the intervertebral interval opposite the level of insertion of a lumbar puncture needle. This was followed by localized arthritic changes, sclerosis, lipping and osteophyte formation. These same changes occur most often when the disc has been crushed, but Keyes and Compere showed that artificially injured cartilage plates with resultant herniation into the spongiosa of nuclear material was followed by thinning of the disc with lipping and spur formation.

The discs seldom are involved in disease of infectious or neoplastic origin with the exception of advanced tuberculosis and acute staphylococcal osteomyelitis. They may also be involved in syphilitic spondylitis and osteoarthropathy.

Calcification of the intervertebral disc may occur either in the nucleus or the annulus and consists of amorphous lime carbonates and phosphates, and even of uric acid. These calcium deposits always are preceded by the formation of soaps in degenerating tissue with attraction of calcium salts. In children the deposits are accompanied by severe local symptoms of backache, muscle spasms and restriction of motion with constitutional symptoms of moderate fever and malaise resembling influenza. There may be gradual absorption of the deposits following clinical improvement.

Calcification occurs eleven times as frequently in the annulus as in the nucleus and is part of the degenerative process in older people without

clinical symptoms in the majority of instances.

Adolescent kyphosis occurs about the twelfth year and is characterized by the development of a rigid smooth kyphosis with roentgenologically demonstrable changes in the bodies of the vertebrae consisting of irregularities of the margin of the bone opposite the discs which are invariably narrowed. The dorsal column is most frequently involved, with a greater incidence in boys than in girls. Pain on exertion is the most common symptom. If recognized early, the deformity may be minimized by immobilization.

Schmorl, Beadle, et al, have demonstrated by postmortem evidence that prolapse of the nucleus pulposus into the spongiosa of the vertebral bodies may occur as a result of congenital weakness of the cartilage plates. Among the other causes suggested have been endocrinal disturbances, nutritional factors, infection and vascular changes from trauma. In the majority of cases the disc is profoundly affected and the spine changes are without doubt related to the early degeneration of the discs.

Doctor Frantz has pointed out the clinical factors of abnormal functional demands with or without an abnormal back. He has made several interesting contributions to treatment in his article on "Juvenile Kyphosis" (which will appear in an early issue of Surgery, Gynecology and Obstetrics). He outlines the treatment of more than fifty cases stressing immobilization supplemented by physical therapy and braces as aids in producing a back capable of meeting adult needs.

Senile kyphosis, according to Knaggs, is characterized by an upper dorsal curve and atrophy of the intervertebral disc anteriorly with contact of neighboring vertebral bodies and resultant ankylosis, but the vertebral bodies do not become as cuneiform in shape as in adolescent kyphosis.

Spondylosis deformans or spondylitis osteoarthritica is separated into two types. In the first, spondylitis ankylopoietica, or rheumatoid arthritis of the spine, the lesion is recognized, except by Krebs, as being primary in the intervertebral joint spaces which tend to disappear, and are being replaced by bone. That this is of an infectious nature is suggested by increased sedimentation rate and the clinical findings. The second group, spondylitis osteoarthritica, is considered to be on a toxic basis.

PROTRUDED INTERVERTEBRAL DISC

In considering the problem of protruded intervertebral discs let us begin with the history[1] of a patient who on the morning of February 19, 1939, when stooping to put on her slippers, was gripped by a stabbing pain across the lower part of the back, which made it impossible for her to straighten up for two hours. The pain persisted all day and made her walk "crab-wise." Next day the back pain was a little easier. She thought this was just another attack of sciatica (such as those she had following the vaulting of a 5-foot fence in 1924) until she began to have pain in the right buttock and down the back of the right leg. Her previous attacks had always been low back pain with left-sided sciatica brought on by unusual exertion. Recovery occurred after two or three weeks of bed rest following such attacks.

On February 21, 1939, she was admitted to a hospital because of pain so severe that morphine had been required to control it. She complained also of numbness along the outer border of the right foot and in the lateral three toes. There was no disturbance of sphincter control. She could attain some comfort by lying on her left side with the right hip and knee partly flexed.

On examination there was flattening and rigidity of the lumbar spine and a slight lumbar scoliosis with the convexity to the right. There was slight wasting and weakness of the muscles in the anterior tibial and calf groups, and the right ankle-jerk was absent.

The right sciatic nerve was very tender on pressure in the buttock and manipulations involving stretching of the nerve caused agonizing pain in the buttock and down the back of the limb. There was slight impairment to pinprick and cotton-wool along the outer border of the right foot and ankle and in the lateral toes. Position sensibility was defective in the little toe.

Roentgenograms showed only the spinal deformities mentioned above. The cerebrospinal fluid contained 65 mg. per cent of protein but otherwise was normal. Lipiodol studies revealed a slight lateral indentation on the right side opposite the lumbosacral disc, with defective filling of the sheath of the fifth lumbar root.

At operation, a prolapsed fragment of nucleus pulposus, compressing the edematous and thickened root, was removed from the lumbosacral disc. The patient was free from sciatic pain when she recovered from the anesthetic. She walked three weeks after operation and at the end of six weeks had resumed her housework. She has had no recurrence of symptoms.

This case well illustrated the findings which occur in prolapse of the nucleus pulposus, but unusual stress or strain may cause herniation of

the annulus fibrosus without permitting a rupture of the nucleus, or the extrusion of a fragment of nuclear material by the pressure under which it is normally confined. In rupture of the nucleus pulposus, the fragment will form a small rounded swelling separated from the vertebral canal and its contents only by the posterior longitudinal ligaments. Since the rupture occurs lateral to the cord for the most part, it may, on swelling, compress the nerve root arising from the next higher segment, making manifest the characteristic features of sciatica.

If the initial rupture of the annulus fibrosus is incomplete no nuclear material may escape, but a weak place may be left in the ring through which a prolapse may occur as the result of a subsequent injury.

In association with each of these types of lesion, the ligamentum flavum may be abnormally thickened and can produce the same symptoms as a damaged disc by the compression of the nerve-root from behind, just as the damaged disc compresses it from the front.

Pennybacker reports in a limited series of 30 cases that the lesion was a prolapsed nucleus pulposus in 23; herniation of the annulus fibrosus in 5, and a small fibroangeioma in the 29th case, but that no demonstrable lesion was found to explain the sciatic pain in the 30th unless it could be explained on the basis of a thickened ligamentum flavum. Both in this series and in the series reported by Love at the Mayo Clinic, over 90 per cent of the lesions were found in either the fourth lumbar or the lumbosacral disc in equal numbers. Protrusions may, and do, occur also in the cervical and thoracic regions.

The patient may or may not sustain a severe injury. The most common types of injury are those sustained when the patient is attempting to lift a heavy object with his back bent forward; when he executes a sudden forceful sitting position as on a slippery pavement, or when he suffers a miss-step while carrying a heavy object, such as a sack of grain on his shoulder.

The onset of pain may be immediate—the patient may hear a snapping sound and be unable to straighten up from a stooped position. He may experience momentary pain after which he is able to proceed with his work for a time, but after hours to weeks, severe pain returns, especially if aggravated by further lifting or straining of the back. Many are conscious of a "weak back" requiring rest in bed. Occasionally the pain persists necessitating surgical removal of the protrusion to give relief. The symptoms of protruded intervertebral disc are apt to be intermittent rather than progressive, as in the case of intraspinal neoplasms, yet partaking of the characteristics of root pain associated with spinal cord tumors in that the pain is exaggerated by coughing, sneezing or straining.

The patient presents himself with slow, guarded movements, walking with a list to one side and with limitation of his spinal motions. There is spasm of the erector spinae muscles and an obliteration of the normal lumbar lordosis. Straight-leg raising (Lasegue's sign) is painful and Kernig's sign is positive. The Achilles tendon reflex usually is diminished or absent on the side of involvement of the sciatic pain. The sciatic nerve usually is tender to palpation, and there may be paresthesias and sensory impairment along the lateral aspect of the foot. In addition there may be slight wasting and weakness of the muscles of the anterior tibial and calf groups. Some patients have an area of tenderness in the buttock. Rarely is the lesion extensive enough to block the spinal canal, but if such a block has occurred, there is likely to be a paralysis of the legs.

Narrowing of the fourth or fifth lumbar intervertebral disc is suggestive evidence of a prolapsed nucleus pulposus. Roentgenographic films of the spinal column and pelvis are of more importance as a means of excluding other lesions than as a method of diagnosing protruded intervertebral discs.

Diagnostic puncture rarely demonstrates a block. In two-thirds of the cases there is an increase in total protein in the cerebrospinal fluid. To confirm the diagnosis made on the basis of the above findings and to determine which disc has protruded, a contrast medium in the spinal subarachnoid space may be introduced using either air or lipiodol, air being less irritating.

Although it is usually the sciatic pain which brings the patient to a physician, nearly all of them have periods of low back pain which is probably a symptom of injury to the intervertebral disc. Pain is confined to the back until a nerve root is compressed; then the pain begins to radiate down the limb. Both the back pain and the sciatica are variable in incidence and severity with periods of relative remission or complete freedom from pain being common. In some cases the sciatic pain may be absent for ten to fifteen years, or it may be almost constant, varying in intensity, being aggravated by exertion, jolting, coughing or sneezing which may be explained by the frequent operative finding of a freely moveable fragment under the posterior

ligament. Relapses may occur from edema of the protruded cartilaginous fragments.

Herniation of the annulus fibrosis is characterized on the other hand by chronic continuous pain which is rarely as severe or disabling as is the acute pain of a prolapsed nucleus pulposus.

Treatment after careful diagnosis is the surgical removal of the ruptured nucleus pulposus. An incision is made in the midline extending across the tips of two spinous processes. The erector spinae muscles are reflected subperiosteally to minimize bleeding and to facilitate closure. If the operation is to be a hemilaminectomy, none of the spinous processes is removed. At most, two spinous processes are sacrificed. The laminae are carefully removed, separating the usually thickened ligamentum flavum. The enlarged, edematous nerve root is thus exposed and retracted to reveal the posteriorly protruded fibrocartilaginous mass or disc, which should be removed extradurally. The dura may then be opened if it is necessary to remove radiopaque oil. This technic prevents obscuring the field by arachnoid hemorrhage before removal of the disc and lessens the likelihood of trauma to an already injured nerve root by allowing the cerebrospinal fluid within the dural sac to act as a buffer. Should one accidentally open an inflammatory mass, such as a tuberculous abscess, the meninges would not be contaminated. Pus on the outside of the dura is relatively innocuous, whereas pus in the subarachnoid space is likely to result in meningitis and death.

Whenever possible, the operative wound is closed without drainage. The muscles are sutured across the midline as is the fascia and skin.

In a recent report Love cites over twenty-five cases in which by resecting the ligamentum flavum without disturbing either the laminae or spinous processes, there was found to be sufficient space to remove the protruded disc without removal of bone, thus preserving in postoperative roentgenograms the same bony structure as in the preoperative films.

This latter method facilitates postoperative care, the patient being permitted to go to the bathroom the day following the operation if he wishes. The cutaneous sutures are removed on the tenth postoperative day. The patient leaves the hospital by the twelfth day, shortening the hospital stay by two weeks. Postoperatively the patient should return to his duties gradually. Love reports five recurrences in a series of more than 500 cases operated at the Mayo Clinic.

The various disorders of the intervertebral disc have been discussed with special reference to the problem of ruptured nucleus pulposus as related to sciatica and low back pain.

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Exercise Following the Reconstruction Surgery of Arthritis

Robert L. Preston, M.D.

Joints which have been destroyed by arthritis can be rehabilitated by corrective surgery. The reconstruction surgeon, who is accustomed to operating upon arthritics, can easily restore a satisfactory range of passive motion to the joints. However, this passive motion is of no value to the patient. Immediately after operation the arthritic patient is no better off than the victim of infantile paralysis who cannot walk because of the flail-like instability of his paralyzed leg. The arthritic patient does not get any benefit from the operation until the reconstructed joint can be completely controlled by active muscle effort. The active motion is restored by a carefully supervised course of corrective exercise.

As the deformities of arthritis develop, gradually limiting the range of active and passive motion in a joint, a gradual loss of muscle strength occurs. After the full range of passive motion has been restored by operation it will be discovered that the patient can actively move the reconstructed joint only through the range of motion which was present just before the operation. Although there are no pathological changes in the active motor apparatus, the disuse of the muscles has resulted in such severe atrophy that many of them have become as weak as if they were almost completely paralyzed. Thus it is apparent that function cannot be restored unless corrective exercise can bring about a return of synchronized active strength to these long unused muscles.

Therefore, in evaluating the various elements of the rehabilitation treatment of a badly crippled arthritic we must consider that the surgery is responsible for 10 per cent of the functional improvement and that the postoperative corrective exercise is responsible for 90 per cent of the restoration of function. The surgeon accepts only 10 per cent of the responsibility for the success of the reconstruction and places 90 per cent of the responsibility upon the shoulders of the corrective exercise technician. This is an unfair delegation of responsibility if another important factor is not taken into consideration. This factor is the willingness of the patient to cooperate in doing the corrective exercise. Nothing can be accomplished unless the patient is psychologically and physiologically able to carry out the exercises in an efficient way.

The surgeon attempts to avoid operating upon any patient who is psychologically unable to carry on a monotonous course of corrective exercises after operation. He also attempts to rule out those patients who, although they have the determination, intestinal fortitude and persistance to perform the postoperative exercises, do not have the stamina for it. These patients, after a few days or weeks, develop such fatigue that the daily routine of exercise has to be reduced to an inefficient level. The end-result in these cases is just as bad as if the patient was psychologically unsuitable because there is a very definite time limit within which active function of the joint must be restored. After the operation scar tissue gradually reforms around the joint so that unless full active motion is secured in a relatively short time some of the range of passive motion is lost.

During the past few years the technic of the surgical reconstruction of the joints of arthritics has been so improved that we are now certain of restoring a satisfactory amount of function to a badly disabled joint if the patient is properly selected and if he can be given proper postoperative exercise. The technic can best be illustrated by discussing the treatment of severe osteoarthritis of the hip joint.

Restoration of Motion in Severe Osteoarthritis of the Hip

In this condition there is a gradual loss of motion in the hip over a period of many years. The severe pain on all motion eventually brings the patient in for operation. The posture is typical. The hip is held in a position of 45 de-

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Read as part of the "Round Table on Arthritis" at the Annual Convention of the American Physiotherapy Association, New York City, June 1940.

grees of flexion, extension beyond this point being impossible. There is usually about 45 degrees of active and passive flexion. The hip is held in extreme external rotation, there being no active or passive rotation whatsoever. It is held in nearly full adduction, all abduction being lost. There is pain at the extremes of all motion. This posture results in a marked practical shortening which in most cases is between one and three inches. The flexion deformity of the hip results in severe lordosis of the lumbar spine. By the time the patient comes in for operation the strain on the other hip joint and the lumbar spine usually has resulted in low-grade osteoarthritic changes of these joints also. (Figure 1 shows the x-ray of a typical case.)

Figure 1. X-ray of a typical case of severe osteoarthritis of the hip. The large osteophites (O) projecting from the head of the femur and the rim of the acetabulum, block almost all motion. They also irritate the lining of the joint causing a marked increase in the thickness of the synovial membrane (to as much as one inch) and chronic synovitis. The chronic synovitis is the cause of the pain in osteoarthritis of the hip.

The operation usually done consists of removing enough excess bone to restore the head of the femur and the acetabulum to as near to their normal size and shape as possible. A metallic cap[1] made of a nonferrous alloy called vitallium is then inserted to line the new hip joint (Figure 2). At the time of the operation all the soft tissue contractures and the thickened synovia and capsule are removed so that while the patient is on the operating table a normal range of passive motion is secured in the hip.

Figure 2. The Albee-Preston vitallium cap for arthroplasty of the hip. The flanges and a bolt inserted through the pelvic bone firmly immobilize the cap. This eliminates the postoperative pain resulting from the instability of the cap. The flanges, which cover the rim of the acetabulum, prevent the reformation of osteophytes from the most common site, the attachment of the capsule.

A plaster-of-Paris cast is then applied which immobilizes the hip in a position which is exactly opposite to the position in which it was held during the years of deformity; that is, full internal rotation, full abduction and full extension. The cast remains on until the soft tissues heal which usually takes ten days. It is then discarded and the patient immediately starts active and passive motion of the hip.

At this time it will be discovered that the patient has completely lost the strength of the abductors of the hip, of the internal rotators of the hip and the hyperextensors of the hip, and that he has a partial loss of strength of the extensors of the knee.

Patients who have had a severe flexion deformity of the hip almost always have slight flexion deformity of the knee. The knee must be manipulated and stretched into full extension at the time of the operation on the hip. Until sufficient active control of the extensor muscles of the knee has been developed to permit the patient to lock the knee securely in full hyperextension, it is impossible to begin the development of the stabilizing muscles of the hip. Therefore, the corrective exercise is divided into three phases. In each phase an attempt is made to strengthen the active power of all the muscles of the hip and knee, but during the first period the emphasis is placed upon the active development of the extensor muscles of the knee; during the second phase the muscles (whichever they may be) which are needed to enable the patient to walk without the use of crutches are developed. As soon as the patient is able to walk without support the third, and most important, phase of the corrective exercise program starts. During this period the emphasis is placed upon the development of the abductor muscles of the hip.

First Phase of the Corrective Exercise—Development of Active Extension of the Knee—

First, the various elements of a normal synchronized stride are demonstrated. As the technician walks back and forth in front of the patient he points out that, at one portion of the stride, the knee must be held in complete extension. This instant of complete active extension of the knee is the only time that the knee actually supports all of the body weight. The patient readily understands that the extensor muscles of the knee must be able to contract at exactly the right time and must be able to hold the knee firmly locked during the short interval of actual weight bearing. If the knee is locked too late or if it is not held firmly the result is instability and a bad limp. The technician then holds the knee in full extension, with the patient lying in bed, and asks him to contract the quadriceps muscle. The technician gradually lets the knee flex to the point where the patient is able to hold it. The patient is then ordered to relax.

It will be noticed that there is a marked delay in the beginning of the contraction of the quadriceps and that during the time the muscle is supposed to be held in firm contraction there are irregular, involuntary periods of relaxation. The first thing the patient must learn is to contract the muscle instantly when sharply ordered to do so and to hold it firmly until he is given a sharp command to relax.

Great care must be taken in all corrective exercises of arthritic patients to avoid overtiring the weakened muscles. The exercises must be repeated many times during the day but a sufficient interval must be allowed between each to permit the muscles to recover their strength. The efficiency of the muscles will be decreased for several days following an overambitious exercise session.

As soon as the cast is removed manipulation of the hip is started. This continues each day until a normal range of passive motion has been secured. Heat and massage also are used every day to minimize the spasm and tenderness of the hip and knee muscles. After about a week the patient usually will be able to get out of bed and sit in a chair. In a few more days he will start to walk, usually with the aid of crutches. Occasionally he only needs to use a cane.

Second Phase of the Corrective Exercise—Development of Active Motion in the Hip

By this time the patient has developed good active hyperextension of the knee and the emphasis of the corrective exercise is shifted to the development of the active strength of all the muscles of the hip. The technic is the same as that used for the knee—the hip is placed in various positions by the technician and the patient is ordered to hold it. Sharp commands are used and each exercise period is very short.

Between the periods of exercise in bed the patient walks, using his crutches or cane, under the critical eye of the technician who "nags" him about standing up straight, fully extending the knee and holding the trunk steadily. During this phase of the corrective exercise program the worst of the hangovers from the patient's old posture habits, developed during his years of deformity, must be eliminated. About two weeks after the patient gets out of bed he will be able to walk without the support of crutches or cane.

Third Phase of the Corrective Exercise—Development of the Abductors of the Hip

This is the phase of the treatment in which the surgeon is most dependent upon the work of an intelligent corrective exercise teacher. Almost any patient, handled in any way, can eventually get up to this point, but if he is to be completely rehabilitated and is to be able to walk with a normal gait he must conquer the most difficult of all corrective exercise problems—the weakness of the abductor muscles of the hip.

When the patient begins to walk without the use of support it will be noticed that there is marked instability in the operated hip. He walks with a shuffling gait, his weight remaining on the unoperated extremity for a relatively long period and on the operated extremity for the shortest possible length of time. It will be noticed that the trunk shifts toward the side of the operated hip at the time that extremity is bearing weight.

At this point the physiology of stabilization of the hip joint should be reviewed. The simple mechanical principle which is the basis of the problem is illustrated in Figure 3. Figure 3-a shows a weight resting on the top of a strong support which is firmly anchored in the ground. It can readily be seen that the weight would fall off the support if it was not in balance. Figure 3-b shows that this weight can be supported even though it is not balanced on the flexible pivot if a guy wire (A) is properly applied. It will be noticed that there is a break in the middle of the support which does not impair its mechanical efficiency if the wires (E) are fastened securely enough to lock the two fragments firmly together. However, it can readily be seen that the off-balance weight in Figure 3-b

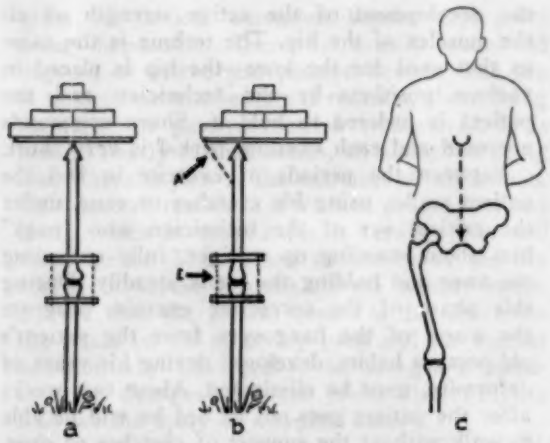

Figure 3. Diagram of mechanics of hip joint stabilization. (A) Guy wire having the same function as the abductor muscles of the hip. (E) Guy wires having the same function as the extensor muscles of the knee.

could not be supported by the guy wire (A), no matter how strong, if the break in the middle of the support was not firmly held. Figure 3-c shows, diagramatically, the similarity between the preceding diagrams and the normal stabilizing mechanism of the hip. The only time that the hip must be stable is the period when the opposite foot is off the ground. At that time the same mechanical imbalance which is seen in Figure 3-b is present. The trunk will be held in a neutral position and the patient will not fall during the stride if the guy wires, in other words, the abductor muscle group and the knee extensors, are firmly tightened and are strong enough to hold the joints rigidly against the resistance of the entire body weight.

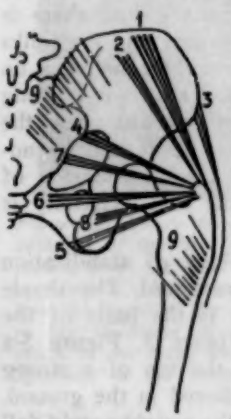

Figure 4. Diagram of the abductor muscles of the hip. (1) Gluteus medius. (2) Gluteus minimus. (3) Tensor fascia lata. (4) Pyrioformis. (5) Obturator externus. (6) Obturator internus. (7) Gemellus superior. (8) Gemellus inferior. (9) Gluteus maximus.

Figure 4 illustrates, diagramatically, the abductor muscles of the hip. The most important is (1), the gluteus medius. Strictly speaking, the remainder are not true abductors, their principle functions being the control of the other motions. The muscles are tabulated in the order of their importance as stabilizers of the hip. These muscles are all small and have poor mechanical efficiency because of the shortness of the physiological levers upon which they pull. For this reason they are normally ill equipped to support the off-balance weight of the pelvis and trunk.

Figure 5 illustrates the effect of the absence of abductor muscle power when the patient attempts to walk. In Figure 5-a it can be seen that, unless the pelvis is supported at a right angle with the femur, the center of gravity shifts far to the opposite side when the opposite foot is taken off the ground. It is obvious that the patient will fall immediately unless he quickly shifts his center of gravity so that his weight is balanced over the operated hip. All of the patients accomplish this by the maneuver shown in Figure 5-b. The patient can walk without the use of the abductors of the hip but the oscillating, unsightly and fatiguing shifting of the trunk shown in Figure 5-b will persist until the abductor muscle strength has been restored.

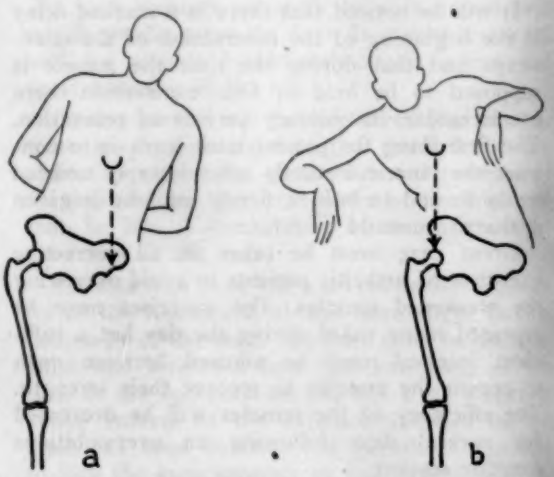

Figure 5. Diagram showing the effect of abductor muscle weakness.

The problem, therefore, is to restore the normal gait by training the patient to walk with the trunk held steadily in neutral position and with the weight remaining on each foot for the same length of time.

First, the patient stands in front of a mirror with the foot of the operated extremity raised off the floor. He is asked to notice the absence of shift of the trunk and to describe what he does to stabilize the normal hip. Usually the patient has never before realized that he has been automatically contracting the abductor muscles of his normal hip when walking. He is then

asked to bear weight on the other foot and stabilize the operated hip in exactly the same way. This is one of the most valuable exercises. It is repeated many times a day.

Figure 6-a shows an exercise which is done with the patient lying on the opposite side. The corrective exercise technician abducts the operated

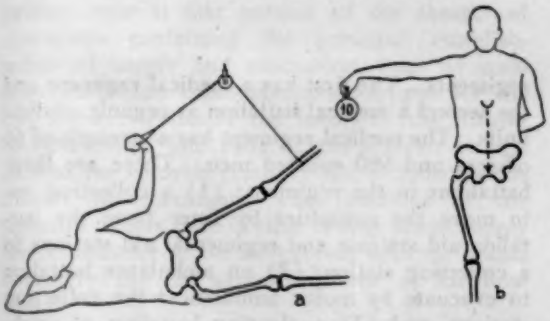

Figure 6. Diagram of exercises for the development of the abductor muscles of the hip.

hip and then sharply orders the patient to hold it. As the support is gradually lowered the patient attempts to hold the hip in abduction. After a few seconds the technician orders him to relax. The exercise is repeated after a few minutes rest. The patient will soon discover that he is able to support the leg in a fair amount of abduction if the hip is permitted to flex slightly. This flexion must be avoided as the gluteus medius will not be developed by this exercise unless the hip is held in weight-bearing position—that is, in slight hyperextension. After the patient thoroughly understands this exercise he can do it by himself with the help of a rope and pulley.

When the patient walks it is desirable for him to carry a ten pound weight in the hand on the side of the operated hip (Figure 6-b). This amount of weight usually counterbalances enough of the weight of the trunk so that the slowly strengthening abductor muscles can begin to hold the body in neutral position. As the muscles become stronger the amount of weight is gradually diminished. The same balancing effect can be secured by the use of a light cane in the other hand. The patient gradually diminishes the pressure on the cane as the abductor muscles become stronger. When the patient is walking the corrective exercise technician constantly reminds him to keep his weight on the foot of the operated extremity for as long a time as it remains on the other. It helps, in some cases, to have the patient visualize and try to imitate the stately ecclesiastical stride of a bishop approaching the altar.

SUMMARY

1. The restoration of function following reconstruction operations on patients with severe arthritic deformities is principally dependent upon the effectiveness of the postoperative corrective exercise.

2. With the improved surgical technics the end-result is good if the patient is psychologically and physiologically able to carry on the postoperative corrective exercises until the atrophied muscles have developed normal, synchronized strength.

All of these exercises are repeated many times a day. As the patient begins to get fatigued from one he changes to another.

As soon as the routine is thoroughly understood by the patient and he is able to do the exercises in an efficient way, it is safe to stop treatment. For the next four to six months the patient must return to the corrective exercise teacher for two or three days training once a month. This is necessary because, no matter how conscientious and intelligent the patient is, he tends to drift into slovenly or inefficient exercise habits when he works alone. Nonspecific generalized exercise will never produce a normal gait in these arthritic patients. The special corrective exercise must be continued until the abductor muscles are strong enough and well enough synchronized to enable the patient to walk with the trunk held steadily in neutral position and with the weight remaining on each foot for the same length of time. This can be accomplished in every case if the patient will cooperate and if he has the privilege of working with a good corrective exercise teacher.

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Physical Therapy in the Army

John S. Coulter, M.D.

The general functions of the medical department of the army are: (1) the preservation of the strength of the forces in the field; and (2) the care and treatment of the sick and injured men so that casualties may be more promptly returned to duty. Physical therapy aids in this treatment of the injured by shortening the time of temporary disability and lessening the amount of permanent disability. The Surgeon General of the Army appreciates the importance of physical therapy. He recently stated: "We are very anxious to make adequate preparation for physical and occupational therapy in Army hospitals."

To appreciate the place of physical therapy in the Army program, it is necessary to have a general idea of the method used in the Army Medical Department for the care of the sick and wounded soldiers in camp, on the march and on the battlefield. Each major component of a division is furnished a fixed quota of officers and men of the Medical Department who usually are referred to collectively as the Regimental Medical Detachment. This personnel accompanies the unit to which it is attached in all tactical operations and functions under the immediate control of its commander. In our Army the men who become battle casualties receive their first treatment at the hands of this part of the Medical Department. The medical detachment with an infantry regiment consists of 10 officers and 96 enlisted men.

In combat this medical detachment has the following functions: establishment of batallion and regimental aid stations; finding, tagging and aiding the injured; prevention of unnecessary movement to the rear on account of sickness or injury; the preservation of morale by early medical attention and removal of the wounded; examination of the dead and sanitary supervision of their disposal, and preparation of records of the dead and wounded.

Our Army now has two types of divisional organization: the square type containing 4 infantry regiments—about 18,000 officers and men—and the triangular division with 3 infantry regiments. The first has a medical regiment and the second a medical battalion as organic medical units. The medical regiment has a strength of 66 officers and 980 enlisted men. There are three battalions in the regiment: (1) a collecting one to move the casualties by litter from the battalion aid stations and regimental aid stations to a collecting station, (2) an ambulance battalion to evacuate by motor ambulances the collection stations, and (3) a clearing battalion to establish a clearing station for the sorting and temporary care of battle casualties in the combat area. The medical battalion of a triangular infantry division has the same organization of less strength and with three companies.

The patients are evacuated from the clearing stations to surgical hospitals which have a capacity of 400 patients. They give immediate surgical aid to the more serious types of casualties. They are assigned to the support of division clearing stations. Patients are evacuated by ambulance to evacuation hospitals. Ordinarily there are assigned to one field army in addition to other units, eight surgical hospitals, ten evacuation hospitals and one convalescent hospital.

The evacuation hospital has a normal capacity of 750 beds and receives its patients from the clearing stations and surgical hospitals established in the combat zone. Evacuation hospitals are primarily for use during battle, but they also may be established to receive sick and injured from concentration or rest centers and from large marching columns when station hospitals or general hospitals are not available for this purpose. They constitute the neck of the funnel through which all casualties must pass in their transit out of the combat zone to the fixed hospital of the communications zone. When battle is imminent, evacuation hospitals in sufficient number to meet expected needs (usually about one for each frontier division) are located and opened.

The convalescent hospital has a capacity of 3,000 beds and is designed for slightly ill, venereal and convalescent patients. It plays an important role in the conservation of the troop strength of the combat zone.

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In military tactics, the theater of operations is that part of the theater of war in which operations are conducted. It is divided, for the purposes of combat and for decentralization of administration, into a combat zone and a communications zone. The combat zone is the forward area of the theater of operations. The communications zone is that portion of the theater of operations containing the principal establishments of supply and evacuation, lines of communication and other agencies required for the continuous service of the forces of the theater of operations. The zone of the interior is that part of the national territory not included in the theater of operations. The functions of the agencies of this zone in time of war are to supply the commander of the field forces with the means necessary for the accomplishment of his mission.[1]

The surgical, evacuation and convalescent hospitals are all in the combat zone. One of the most important duties of the medical department is the evacuation of the sick and wounded in all theaters of operations. The difficulties and magnitude which this task may assume should be understood by all concerned. In the operation of a large force against strong resistance, as much as one-fifth of the troops may have to be evacuated from the combat zone to the communications zone in a relatively short period. This movement of noneffectives from the combat zone is properly conceived as being in the nature of a withdrawal. Its execution is a responsibility of the medical service. The evacuees are unorganized, nonselfsupporting and are gathered individually from all units of the field forces. They require individual care, treatment and handling through all the stages of their withdrawal from points in the forward area to the hospitals of the communications zone. It can be understood, therefore, that physical therapy cannot be started in the hospitals of the combat zone.

In the communications zone the most important hospital unit is the general hospital. In a communications zone with six field armies in the theater of operations there would be authorized 300 general hospitals for the communications zone. The number of general hospitals allotted to the communications zone would depend upon the location of the communications zone in relation to the zone of the interior, the extent of the zone and the number of troops involved. Under certain conditions there may be no need for general hospitals in the communications zone, while under other conditions, such as with an oversea expeditionary force, a large number may be required.

The general hospital is a fixed unit of 1,000 beds capacity, designed for the treatment of all cases arising within the theater of operations and located a sufficient distance from the combat zone so that military reverses will not disturb their operation. Its equipment is adequate for the care of all cases whatever the severity. Although designed for the definitive treatment of cases, in a prolonged campaign, it will be necessary to evacuate patients from these general hospitals to general hospitals in the zone of the interior, especially those cases that are not likely to be fit for service for a considerable time, or who will be incapacitated permanently for further military duty.

The tables of organization allow a general hospital a personnel of 73 commissioned officers of the medical department, 120 nurses and 500 enlisted men. This hospital of 1,000 beds has one head physical therapy aide and 7 physical therapy aides.

Station hospitals are designed to render general medical and surgical treatment for those areas where they are needed but with insufficient military population to justify general hospitals. The normal capacities are 250 patients with 2 physical therapy aides; 500 patients with 4 aides, and 750 with 6 aides.

General hospitals should be located at points which afford good rail or water connection with regulating stations and with the zone of the interior. The presence of suitable buildings and utilities is most advantageous, but additional construction usually will be required. In planning construction consideration should be given to the availability of nearby landing fields for airplane ambulances.

General hospitals, when conditions permit, are organized into groups of 3 to 10. This group is called a hospital center. Each hospital center contains a convalescent camp which normally will have a bed capacity equivalent to 20 per cent of that of the center. Patients who no longer require careful hospital treatment but who are not yet fit for duty will be transferred to this camp, where they are prepared for duty by a system of graduated exercises.

As the equipment of a general hospital should be adequate for the care of all cases, it is here that physical therapy should be started in the care of many fractures, dislocations, wounds and amputations. In the First World War physical therapy was started in the general hospitals and hospital centers of the Army of

the United States in France and was most effective in reducing the length of temporary disability and the amount of permanent disability.

The Surgeon General of the Army recently stated that it would be the policy of the Medical Department of the Army in the next war to discharge all wounded men requiring prolonged hospitalization to the Veterans' Administration for treatment in their hospitals. This would mean that the care of cases requiring long hospitalization by the Veterans' Bureau would lessen the number of army general hospitals in the zone of the interior. At the same time this would not lessen the number of wounded in the country which require physical therapy.

The Surgeon General of the Army on February 19, 1941, issued a circular which is of interest to all physical therapists.

"CIRCULAR LETTER NO. 8

"Subject: Physical Therapy Service in Army Hospitals.

"1. There have recently been evidences of misunderstandings relative to the use of Physical Therapy Aides in Army hospitals. In order that uniformity may exist in the Physical Therapy services, this circular letter is published for the information and guidance of all concerned.

"2. Physical Therapy is the treatment of disease or injury by physical means. It includes treatment by Hydrotherapy, Electrotherapy, Thermotherapy, Massage, and Therapeutic Exercise. This treatment is performed by trained Physical Therapy Aides, if available, under the direction of the Medical Officer.

"3. The position of Physical Therapy Aide in the Medical Department of the United States Army is available to either men or women regardless of their marital status. Applicants must be citizens of the United States, graduates of a course in Physical Therapy approved by The Council of Medical Education and Hospitals of the American Medical Association, and must have been certified by the Civil Service Commission. In obtaining their registration with the Civil Service Commission, they will have been required to conform to certain height, weight, age and physical requirements. In the event that the Civil Service Commission cannot certify eligibles, Physical Therapy Aides who have enrolled with the American Red Cross or other Physical Therapy Aides may be employed. It is desirable that all Physical Therapy Aides, who are employed outside of Civil Service, make arrangements to obtain a Civil Service Status as soon as practicable. Files of Red Cross Enrollees are available at Corps Area Surgeons' offices and when eligibles are not available from the Civil Service register, Station Hospital Surgeons should contact the Corps Area Surgeon for a list of Red Cross Enrollees.

"4. Physical Therapy Aides are civilian employees of the Medical Department. The grades are (1) Physical Therapy Aide and (2) Head Physical Therapy Aide. Head Physical Therapy Aides are utilized in departments having three or more Physical Therapy Aides. There is also a Chief Physical Therapy Aide at Walter Reed General Hospital, Washington, D. C., who is supervisor of the training course for Physical Therapy at that hospital. All original appointments should be made in the lowest grade. Promotions to a higher grade are made by The Surgeon General of the United States Army on recommendation of the Commanding Officer of the hospital.

"5. Physical Therapy Aides are to perform all Physical Therapy treatments, keep all records incident thereto, perform all duties necessary in the maintenance of Physical Therapy clinics in a neat and orderly manner, and to perform such other duties as may be assigned by the immediate superior.

"6 Socially, the Physical Therapy Aide will be expected to conform to the rules that govern the conduct of a member of the Army Nurse Corps.

"7. Insofar as rooms ars available in the Nurses' Quarters, Commanding Officers of the hospitals may assign single female Physical Therapy Aides thereto.

"8. Female Physical Therapy Aides will provide themselves with uniforms in accordance with the description attached hereto. Male Physical Therapy Aides will provide themselves with white duck trousers and coats. The uniform will be worn on duty at all times."

There are four field armies now being organized in the United States. It is estimated that in time of war these four field armies would require 200 general hospitals of 1,000 beds each. As each general hospital has 8 physical therapy aides, these hospitals would require a total of 1,600 physical therapy aides. If we engage in a war of such severity as is occurring in Europe, this number would be inadequate. At present there are 1,029 senior registered physical therapy technicians on the roster of the American Registry for Physical Therapy Technicians. The American Physiotherapy Association has a membership of 1,017. About 75 per cent of the American Registry for Physical Therapy Technicians

are included in the membership of the American Physiotherapy Association. There are, therefore, about 1,274 trained physical therapy technicians in the United States. These technicians are all employed in hospitals, private offices or schools for crippled children or in the state program services for crippled children, sponsored by the Crippled Children's Division of the Children's Bureau of the Department of Labor.

The Subcommittee on Physical Therapy of the National Research Council has completed a survey of the demands for physical therapy technicians for government hospitals, Army, Navy and Veterans' Administration. This survey indicates an immediate shortage of 500 technicians, and a shortage of 1,200 in the next two years. This committee believes that a national emergency is present in the field of physical therapy due to this shortage of physical therapy aides in government hospitals. On October 16, 1940, the Subcommittee on Physical Therapy of the National Research Council wrote to the approved schools for physical therapy technicians asking them if they could increase their number of students and give two emergency courses a year. These schools nearly all agreed to double their capacity and give short courses. Therefore, on May 1, 1941, the committee wrote the schools: "The national emergency is now present."

In giving suggestions for these short courses the committee quoted parts of Circular Letter No. 8 previously quoted in this article. Then the letter stated that the age limit and physical requirements should be those given in announcement 24 (assembled) U. S. Civil Service Examination for Physical Therapy Aides, and the scholastic requirements should be those given by the Council on Medical Education and Hospitals of the American Medical Association for an acceptable school for physical therapy technicians. These scholastic requirements are as follows:

(a) Two years or sixty semester hours of college, including courses in physics and biology, or

(b) Graduation from an accredited school of nursing, or

(c) Graduation from an accredited school of physical education.

A number of schools have proposed plans for a six months' course with the above scholastic admission requirements.

Walter Reed Hospital, with an entrance requirement of a college degree with a major in physical education, is giving a twelve months' course in physical therapy—six months training at Walter Reed Hospital and six months in applicatory training under supervision of accredited physical therapy technicians in Army hospitals.

The Council on Medical Education and Hospitals of the American Medical Association will give consideration and counsel to schools offering their plans for such an emergency abbreviated course.

Some schools, for the first time in recent years, have had difficulty in securing suitable applicants for this course. Usually many applicants are nurses. Nurses now can go into the army with a military status. This has a certain attraction which even a higher salary as a civilian employee cannot overcome. This is especially true since a nurse would be required to take a special course costing her, in most cases, a considerable amount of her savings. Therefore, fewer applications from nurses are being received. This means that these schools for physical therapy technicians must rely on graduates of schools for physical education or college students with a major in biological science.

This offers an attractive field for women in these two classes to serve their country and secure a training for an attractive career in physical therapy after the emergency is over. But few of these students are aware of this opportunity.

The President of the United States in his radio talk on May 27, 1941, stated:

> "Your government has the right to expect of all citizens that they take loyal part in the common work of our defense—take loyal part from this moment forward."

In my opinion the time is now at hand for every member of the American Physiotherapy Association to act on these words. It is believed that every physical therapy technician whose services can be spared and who is physically qualified for service in our government will make the necessary sacrifice to take "loyal part in the common work of our defense." If they cannot serve the government directly, they should take the time and effort to interest eligible applicants for these short courses. Your country and your profession needs your active cooperation now.

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Physiologic Basis of Heat

C. O. Molander, M.D.

The application of heat to the human body either locally or generally from the standpoint of the technician who uses it should be cause for inquiry. Just how do diseased or injured tissues react to the heat rays, and just how do they assist in the repair of human tissues?

There are five ways in which heat is applied—namely, dry heat, moist heat, long wave diathermy, short wave by the electric field method, and the short wave by means of electromagnetic induction. The quality and quantity of radiations emitted from these sources depend not only on the physical properties of the source itself but also on the energy input and the intensity of heat generated in the radiating object.

Dry Heat

For the sake of simplicity let us think in terms of the spectrum and divide infra-red radiation into two major classifications: the far infra-red and the near infra-red.

The far infra-red is emitted by all heated bodies. Low temperature bodies, such as hot water bottles, electric heating pads and dull red heaters emit wave lengths ranging from 8,000 to 120,000 angstrom units. These rays penetrate from 0.05 mm. to 1 mm. and are strongly absorbed in the upper layers of skin. These rays have a marked decongestive and analgesic effect and are used especially in neuritis and neuralgia. If used too much and too long they have a mottling effect upon the skin and result in a rather leathery appearance.

The near infra-red rays are emitted by incandescent bodies such as the sun, electric arcs, incandescent lamps and especially designed infra-red generators. They range from 4,000 to 120,000 A° predominating in a wide band, the center of which is about 12,000 A°. They penetrate from 1 mm. to 10 mm. Therefore, they are able directly to influence blood vessels, lymph vessels, nerve endings and other subcutaneous tissue. In this way the blood is heated.

These shorter rays are but slightly absorbed by the skin. As a consequence there is less reddening by the skin and more perspiration. The analgesic effects are not as marked as in the long infra-red region. They are especially used, therefore, where deeper penetration is indicated, as for example in treating lumbago.

W. W. Coblentz[1], in an article entitled "Sources of Ultraviolet Radiation and Infra-red Radiation used in Therapy," states that "recent transmission measurements seem to indicate that the depth of penetration is not so great as formerly supposed. Furthermore, with increase of knowledge of radiation therapy, less emphasis is being placed upon this question."

Recent studies of temperature sensation by Oppel and Hardy[2] show that the more penetrating the rays the less sensitive the subject is to them, and the less penetrating the more stimulating. However, the amount of radiation, even with penetrating wavelengths, that can be tolerated by the skin is rather low, so that this form of heating is different from that obtained with diathermy machines.

Moist Heat

Moist heat is the application of water of various temperatures and pressures for therapeutic effects. Its chief value lies in the effect upon circulation of the skin and the tonic action upon the nerves locally and generally. Due to the extreme conductivity of water, moist heat gives rise to a more uniform hyperemia than dry heat at the same temperature. However, moist heat is not able to heat the deeper tissues, because increased circulation of blood tends to keep the temperature of the tissue constant. The outstanding effect of moist heat is its ability to produce a rapid vasodilatation in the capillaries and other superficial vessels. Moist heat can be applied with pressure effects or without pressure effects.

Medical Diathermy

Medical diathermy is the use of high frequency currents to produce heat in the body tissues for therapeutic purposes. The heat is in-

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Read before the Chicago Chapter of the American Physiotherapy Association, December 4, 1940.

sufficient, however, to produce temperatures high enough to destroy tissues or impair their vitality. Medical diathermy may be divided into three methods: the conventional long wave diathermy, the short wave by the electric field, and the short wave by electromagnetic induction. As far as is known these currents have no effects other than heat. These currents applied to the human body have the same common effect—the production of heat in the tissues. They vary as to the depth of heating, method of application and mode of operation. There is a thermal gradient from the hot skin and subcutaneous tissues to the less heated tissues within. The heating effect is due to the resistance of the tissues to the passage of currents and is proportional to the electrical energy dissipated in the tissues.

The Conventional Long Wave Diathermy.—The conventional or long wave diathermy has a wave length of from 100 to 300 meters. The generator supplying this current is of the spark gap type, generating an alternating current with a frequency of one to three million cycles per second. The patient is directly connected to the unit by means of metal plates and becomes a part of the electric circuit. This rapidly oscillating current follows the path of least resistance and is transformed along its path into caloric energy. A great amount of the energy is consumed by the skin, resulting in a higher temperature of the skin and the deeper subcutaneous tissues. The high resistance tissues become heated by thermal conduction, resulting in a slower heating of the deeper tissues.

The long wave diathermy is particularly adapted for electrosurgical and internal electrode application. It also is more efficient in treating body parts of considerable extension, such as arms or legs in longitudinal direction.

Short Wave Diathermy by the High Frequency Electric Field Method.—The wave length of this form of diathermy is from 3 to 30 meters. Short wave diathermy machines are vacuum tube oscillators, generating an alternating current with a frequency dependent upon the wave length of the unit used. Short wave currents do not produce neuromuscular responses. The patient has no other sensation than that of a pleasant heat equally distributed over the whole area under treatment. Heating is produced by distortion of the high frequency electric field when the condenser plate method is used. In the technic of application it is well to remember that the correct spacing of electrodes is very important because the electrode skin distance has a very important bearing on depth of heating. There is an area of increased electrical density near the electrodes and when the electrodes are near the skin there is more heating in the superficial areas. The penetration through a dielectric substance is much more in evidence for oscillations of 10,000,000 or more and as a matter of fact represents the chief difference between the short wave diathermy and the conventional long wave diathermy. Therefore, unless there is a spacing of the electrodes at a definite distance from the skin, as prescribed by the machine manufacturers, there will be burns.

Short Wave Diathermy by Electromagnetic Induction.—Heating by the electromagnetic induction method is produced by the action of secondary (eddy) currents induced in the tissues by the electromagnetic field set up by high frequency currents flowing through an induction cable which is placed either around the part treated or over it in the form of a pancake coil. This coil is traversed by an electric current which creates a magnetic field. In a conductive substance inside this field induced currents will arise which flow in a direction opposite to that of the changing current in the coil. This is an *eddy current.* If the strength is sufficient, the eddy current will generate heat in the conductive substance. Heating by this method depends on the length and shape of the coil, the coil capacity, and the wave length used. The heating characteristics by this method are such that optimal heat is produced in the more conductive or more vascular tissues, such as muscles, blood vessels and visceral organs, rather than in the less conductive or more adipose tissues, such as skin and fascia. This undoubtedly accounts for the higher temperatures in the deeper tissues.

Summarizing then, we have heat brought to the part by conduction, convection or conversion. By conduction we mean direct application of heat, by convection we mean radiation of heat, and by conversion the transference of electrical energy into heat energy.

Inasmuch as the skin plays such an important part in the utilization of heat energy it is well to pause for a moment and review its histology and physiology. The skin is divided into the epidermis, a layer of avascular squamous epithelium composed of the stratum germinativum, the stratum granulosum, the stratum lucidum and the stratum corneum, and the derma, a layer of connective tissue containing blood vessels, nerves and lymphatics. The average thickness of the skin is one-eighth inch but varies in different parts of the body. In the avascular layer,

or the epidermis, the epithilial cells push from the stratum germinativum to the stratum corneum, or the skin surface, and become flat—producing dry scales which are rubbed off. In the true skin or derma there are yellow elastic fibers—smooth muscle fibers which are involuntary and attached to the hair shafts—called the arrector pilorum. Some of these elastic fibers serve as tendons for these minute muscles which, when stimulated, contract. In this manner the elastic tissue is stretched and becomes tense; when these muscles relax the elastic tissue becomes pliable.

Let us for a moment consider the structures found in the skin. The hair and sebaceous glands have their origin in the derma. When the arrectores pilorum contract, the sebaceous glands are compressed and a fatty secretion is exuded. This keeps the hairs soft, pliable and smooth and protects them from external irritants. The sweat glands, too, have their origin in the derma and their function is to excrete perspiration—one quart in twenty-four hours for the adult. The stimulants which increase perspiration are exercise, pain, mental excitement and increased temperature or humidity.

Carbon dioxide is given off and oxygen is absorbed in equal amounts. The loss of body heat by evaporation of moisture is balanced by the production of heat. There is an elimination of waste products.

The blood supply are the the capillaries in the papillae. These capillaries are composed of a layer of epithelium which expand and contract and are controlled by vasomotor nerves which regulate the blood supply. One-half to one-third of the blood supply is in the capillary network. These capillaries are in a state of rhythmic activity and produce the skin heat.

The lymph supply is a large network of capillary lymph vessels. The return of this lymph supply to the thoracic duct and the right lymphatic duct depends on the exercise of the limbs. If a patient is unable to exercise, the lymphatic circulation is kept going by passive exercise and gentle massage.

The nerves to the skin are the vasomotor nerves to the walls of the blood vessels, the motor nerves to the sweat glands, the arrector pilorum and the secretory nerves, the nerves for temperature control—the hot and cold spots convey to the central nervous system sensations of heat and cold—and the nerves of touch and pressure and those of pain.

As you know the epidermis is very sensitive to peripheral impressions—and water at various temperatures and pressures is conveyed to the central nervous system and reflexly to the internal organs.

At this point we really should discuss and describe the structure, physiology and chemistry of the single cell as well as the character of the media which surrounds it and the way in which heat and cold affects it, but space will not permit. Suffice it to say that the cell is an organism of great structural complexity and that this cell is closely related to that of the media. Claud Bernard[3] believes that the metabolic conditions of a cell depend on the composition of its media.

When heat is given either by conduction, convection or by oscillations it is transferred to the skin itself or to the deeper structures and is transferred through, reflected or absorbed. It is the heat which is absorbed which produces a vasodilatation. There exists an inherent tone in the capillaries which causes a vasoconstriction, and the application of heat produces the release of a vasodilator substance. Upon the absorption of the vasodilator substance more capillaries become active and as a result there occurs a greater blood supply to the part. By this means the intercellular spaces become enlarged and the blood plasma and heat transference to the tissues is increased.

The absorbed heat produces vasodilatation. This results in an acceleration of the blood stream, the white cells are driven to the periphery of the stream where the flow is slower producing an adhesiveness and thereby making it difficult for them to escape from the wall once in contact with it. There is, however. an increased extravasation of these white cells through the capillary walls, an increased transudation of fluid and as a result the tissues become infiltrated and swell. The arteries and veins are composed largely of muscle while the capillaries are actively contacting tubes. Thus with a vasodilatation and transudation of blood plasma there is an increased capillary pressure and fluid interchange. Temperature changes have a considerable effect on capillary pressure and consequently on the formation of tissue fluid. The hypothesis on which this is based is that the interchange between blood and tissue fluid depend normally on a simple physical balance between hydrostatic pressure of blood in capillaries and the osmotic pressure of colloids which enable them to pass capillary walls and exert an attractive force on watery solutions and diffusible substances. Landis[4] states that the rate of fluid transfer is linearly proportional to the differences in pressure. Drury and Jones[5] say that a

rise in temperature increases the rate of edema formation in a leg when the veins and lymphatics are partially obstructed by a moderate pressure. Thus by this means there is an increased heat transference from blood to the tissues. There is an increase in cell diffusion and it is by this process that there is brought about an exchange of chemical substances between blood and cells. By cell diffusion the chemical composition of the different parts of the cell and between different cells is equalized and without it the chemical change would be practically impossible. The osmotic pressure within the cells is increased. This internal osmotic pressure is counterbalanced largely by the osmotic pressure of fluids outside the cell. The colloids of the cell exert almost no osmotic pressure while the crystalloids do. Therefore, osmotic pressure continually varies. Cell life is looked upon as a constant attempt to re-establish equilibrium, both chemical and osmotic, which is never achieved. Thus, by means of this heat transference to the cells, metabolism of the cell is increased, as for example the O_2 and CO_2 interchange and the assimilation of food which reaches its optimum at 102.6 F.

Before we proceed further let us for a moment note the effects of heat on bacteria. These living unicellular organisms are profoundly affected by heat and cold. For each organism there is some one temperature termed the optimum temperature at which all growth proceeds with maximum speed, possibly for the majority between 75 and 80 F. Above or below this optimum temperature the rate of growth falls off rapidly until at last it becomes too high or too low at which time growth ceases and death occurs. The highest temperature at which death occurs is called the thermal death point.

It is only logical to state at this time then that there must be an optimum temperature at which cell repair must take place at a maximum rate. Unfortunately, we in the field of physical therapy have no way of producing an optimum temperature because in all the devices which we apply to produce heat we are unable accurately to determine the amount of heat needed, the intensity and the length of time we need to apply it. All we know is that radiant heat should be placed at a comfortable distance, that conductive heat and heat by oscillation should be comfortable. There is no accurate measuring device so that we can determine proper dosimetry. This is checked entirely with the patient. The length of time is still arbitrary, varying from ten minutes to, in some cases, twenty-four hours at a time. So it is obvious there is much to be done. Let us assume that we have applied heat for the correct period of time. For most of us we use dry heat and moist heat to produce an erythema which is usually from twenty to forty-five minutes, and the oscillatory form from ten minutes to thirty minutes because of its intensity and greater depth of penetration at a greater speed.

Therefore, heat properly applied plays an important part in cell repair and stimulates various cells to assist in that repair. There are the wandering cells from the tissues themselves, such as the endothelial cells, the advential cells of Morehand, the lymphocytes, the plasma cells, the fibroblasts and the macrophages. There are also fixed cells, as for example those of the blood vessel walls and tissues themselves.

The lymphocytes play an important part. They grow well in diluted serum and have the power of liberating the nutritive and growth producing substances called trephones into the blood plasma and lymph spaces and thus into the epithelium and connective tissue. They act as mobile unicellular glands or nursing cells.

The fibroblasts are very important cells and it is thought that a stimulus to their growth must be a chemical one. In the nuclei of these dividing cells there is a rearrangement of the sulphur in the molecules. The SH is present in all actively dividing tissue and appears to form a most characteristic feature. This substance shows a remarkable effect upon healing of wounds and is called a kind of "wound hormone." This leads to increased differentiation and organization but never to malignacy.

Let us take for example a healing wound with loss of substance. The gap in the surface is filled in by various elements of the inflammatory exudate. There is the coagulated plasma bound together by interlacing strands of fibrin; new capillaries are formed by buds of endothelium from the side and base which grow into the mass, become canalized and fill with blood. Thus the exudate becomes vascularized and the fibrin becomes absorbed. In connective tissue the cells proliferate and develop into plump fusiform cells with vesicular nuclei and branching processes called fibroblasts. This fibroblastic proliferation is the most striking feature in the process of cell repair.

The function of the fibroblasts is to support the capillaries, to permeate with a fibrinic interlacing network, to fill the floor of the gap and to produce a fibrous nonvascular mass called scar tissue.

To summarize, the chemical and physical effects

that occur as the results of the application of heat are:

1. A change in the acid base equilibrium.
2. There is an increased capillary pressure and fluid interchange.
3. Increased heat transference from the blood to the tissues.
4. Increase in cell diffusion.
5. Increase in internal osmotic pressure in the cell.
6. Increase in cell metabolism.
7. Increase in phagocytosis.
8. Increase in antibody content of blood plasma.
9. Relief of pain by relieving nerve sensibility and relaxing spasm.
10. Temperature of tissue is markedly influenced by circulating blood.
11. When tissue drainage by heat is too great there is:
    a. Wheal formation
    b. Tissue coagulation
    c. Charring
12. Factors causing variation in surface temperature are dependent on:
    a. Heat capacity of tissues which is very high
    b. Vascular changes
13. Heat acts as a preliminary for other physical modalities such as massage, electricity and exercise.

CONCLUSION

We can readily see that heat has a real physiologic basis by stimulating the processes of repair so that the area involved may resume to its former normal function.

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Effect of Sunlight on Bone as Reported by Herodotus in 450 B. C.

To the Editor:—In book III of Herodotus's history, in which he describes some of his travels in Egypt and Libya, an account is given of the Persian invasion of Egypt under Cambyses. Near the mouth of the so-called Pelusian Nile, the forces of Cambyses met the Egyptians under King Psammenitus in 525 B. C. Herodotus viewed the battle field about seventy-five years later. His attention was called to the striking difference in thickness and strength of the Persian and Egyptian skulls which were still lying on the surface of the ground. His explanation of this difference is interesting, being so far as I know the earliest recorded definite proof offered of the effect of sunshine in thickening and strengthening bone tissue. A translation of chapter 12 of book III, is as nearly the simple style of the original Ionic Greek as I can make it, runs as follows:

"I saw a great marvel of which I had heard from the natives of the country. The bones of those who fell on either side in this battle lay scattered separately. The bones of the Persians lay in one part of the field and the bones of the Egyptians in another, as the two armies had separately stood. The skulls of the Persians were so fragile that a mere pebble thrown at them would penetrate them. But those of the Egyptians were so strong that you could hardly break them with a stone. The cause of this, so the people said, and I readily agreed, is that from childhood the Egyptians shave their heads, and the bone is thickened by exposure to the sun. For the same reason they do not become bald. Of all races of men bald heads are rarest among the Egyptians. Such then is the reason for their strong skulls. And the reason why the Persians have weak skulls is that they cover their heads all their lives with felt hoods, called tiaras by the Persians. Such are the facts of the case. I noticed the same condition at Papremis in the skulls of the Persians slain by Inaros the Libyan."

E. V. WILCOX, *Chevy Chase, Md.*
—*From "Correspondence," J.A.M.A., May* 13, 1939.

Fever Therapy:

A Discussion of the Present Therapeutic Indications for and the Technic of Administration of Inductopyrexia

D. S. Cowles, M.D.

Introduction

Presenting the entire subject of fever therapy is, at the outset, impossible in so short a discussion, and since you are a group with the widest possible range of information about hyperpyrexia, it is also impossible to present facts unknown to some without at the same time making statements that are obvious and well known to others. I shall therefore attempt to sketch very briefly something of the present uses being made of fever therapy and the more important facts concerned with the technic of administration.

I wish it clearly understood at the outset that any statements I make regarding both use and technic are based on my own experience with inductopyrexia—that is, fever produced by electromagnetic induction and maintained in the usual air-conditioned and humidity-controlled cabinet.

Since fever is produced for therapeutic use by several methods, and since there are still many controversial points, it is my belief that the claims of the various investigators should not be compared except when they are using the same method of fever production. As a corollary to this statement, it follows that much interesting and promising clinical data presented by workers using other methods of fever production will not be presented, since to do so would necessarily lead to confusion. The facts common to all methods will of course be presented, whatever technic was being used at the time of their discovery.

Present Therapeutic Value of Inductopyrexia

Syphilis—The treatment of neurosyphilis by fever therapy has become universally recognized and is being used in most of the better medical centers. For a number of years the production of fever by the inoculation of the patient with live malarial parasites was the only available and even partially satisfactory method. Its use, however, was restricted to the most advanced and oftentimes practically hopeless cases because of the possible danger to the patient from the malaria itself. In the early days of research with this method, under the supervision of the Boston Psychopathic Hospital and under the direction of Dr. Lewis B. Hill, at that time clinical director in charge of research at the Worcester, Massachusetts State Hospital, it was my good fortune to be a member of the staff and therefore to be able to follow the course of many of these early cases. At that time (1925) this was practically the only use being made of fever therapy. Since space does not permit me to follow the chronological development of the therapeutic use of fever in each disease, I shall present the following list in the order of the frequency of their occurrence in our series of cases.

Syphilis still ranks first in the number of cases treated. However, fever therapy is now being used successfully in the treatment of all stages of syphilis. The series of cases we reported in the April 1940 number of the Ohio State Medical Journal showed many striking results. One congenital syphilitic patient, treated medically for years with no improvement, was clinically, markedly better and had negative blood and spinal fluid tests after eight weeks of combined fever and chemotherapy. Another congenital syphilitic with juvenile tabes and optic atrophy had negative blood and spinal fluid tests after fourteen treatments and was able to read ordinary text books. This patient also had had constant medical treatment for four years and intermittent treatment since birth. She was referred to us for fever therapy from the Blind School, where she had been sent to learn Braille. The number of treatments given ranges from one to twenty-four. After six arsenical and

Ostrander, Ohio.
Read before the Ohio Chapter of the American Physiotherapy Association, Columbus, Ohio, April 30, 1941.

twelve bismuth injections over a period of six weeks, some of the more recently infected cases have become negative following a single fever. Paretic cases may require from three to twenty-four treatments. In all cases, fever therapy, to be effective, must be given in conjunction with the usual chemotherapy indicated in each case.

Arthritis—The selection of cases of arthritis for treatment with electropyrexia is quite difficult and will vary according to the experience of the fever therapist making the selection. I believe this difference of opinion may be due in large part to the difference in technic. However, it is obviously true that hypertrophic arthritis cannot be altered by high temperature. On the other hand, the purely rheumatic type, in our experience, has responded very well. We have treated some cases of arthritis of unknown etiology which have not appeared to be clinically improved following the series. However, they have all been given temporary relief from pain. We have had no instance of increase in severity of symptoms following treatment. It undoubtedly is wise to make no definite promise to an arthritic patient except that they may have relief from pain for a length of time which varies widely with individual cases. The actual physiological changes occurring with fever are as yet not sufficiently well known to justify any but the most conservative guess concerning the possible methods of benefit to the patient. Therefore, it is impossible to know in advance just what benefits may be given in these cases in which the disease is so poorly understood from the standpoint of etiology.

Undulant Fever—In 1939 we began using fever in conjunction with sulfanilamide for the treatment of undulant fever. This was suggested by three cases reported by Dr. Walter J. Zeiter at the Cleveland Clinic. Doctor Zeiter's patients, however, had not had sulfanilamide in conjunction with fever therapy. Our first case, a patient who had been acutely ill for five weeks, with a temperature ranging as high as 105 F., was clinically well two weeks after treatment and had negative intradermal and blood tests four weeks after his first and only treatment. He has had repeated negative tests since and has remained clinically well. Several other patients have had to have as many as three induced fevers before similar results were obtained. Our series of these cases is becoming quite extensive and is now being prepared for publication. Several of these cases had previously been given numerous vaccines and medications with no improvement in laboratory findings and only temporary clinical improvement. One patient had been given mild fevers by typhoid injections, in addition to medical treatment, but had not improved clinically.

Gonorrhea—The use of fever therapy for the treatment of gonorrhea is comparatively recent, but it has been quite effective. This is true both in the series we reported in the article in the OHIO STATE MEDICAL JOURNAL, above mentioned, and in the series we have completed since that time. We have been able to obtain negative blood and smear tests and have the patients clinically well after one to three fever treatments. These patients were all given their fever in conjunction with treatment with sulfanilamide. Many of them had had extensive and repeated treatments by the usual douching and urethral irrigations, in addition to vaccine and sulfanilamide alone, with little or no improvement. One patient who had been critically ill with gonorrheal salpingitis and pelvic peritonitis was given fever therapy as outlined above. Six months later, during an appendectomy, her Fallopian tubes were found to be normal.

Rheumatic Fever and Chorea—Following the same procedure as that used in the treatment of undulant fever, we have had very gratifying results in a somewhat smaller number of cases of acute rheumatic fever in children. Children having chorea also are greatly benefited by fever therapy. The residual choreiform movements, which often persist after the removal of the probable causative focal infection, usually are stopped by one or two treatments.

Optic Atrophy and Edema of the Retina—Ophthalmologists have referred cases of syphilitic optic atrophy and edema of the retina of unknown etiology, and both of these conditions have responded favorably.

Osteomyelitis—Several cases of osteomyelitis have been referred to us by orthopedic men in order to shorten the time needed for the development of an abscess and the formation of a sequestrum. This has been accomplished in each case by fever therapy.

Allergy—Hyperpyrexia has been found to be a valuable adjunct in the treatment of certain types of allergy and has given asthmatic patients marked relief for varying lengths of time.

While fever therapy is of value in any of these conditions, it is most valuable when used in conjunction with the usual medical treatment for the disease in question.

Multiple Sclerosis—It is believed that most

cases of multiple sclerosis can be retarded in the development of symptoms by the use of fever therapy, and it is known that in some cases the progress of the disease has been held in check for six years. There is, of course, no improvement in the patient's condition, but in this type of disease any method that will retard progress is valuable.

There is a great deal of research being done with fever therapy in the treatment of several other diseases, but since there is no definite report of clinical cases as yet available, we shall not list them.

TECHNIC

In the discussion of treatment of the various diseases mentioned before, it was made clear that inductopyrexia was used in each case. Our use of this method varies very little from that used by several fever therapists.

Preparation—Before fever therapy is definitely prescribed, each patient should have an X-ray examination of the heart and lungs, an electrocardiographic tracing of the heart, and a study of the blood and urine, in addition to the usual physical examination.

Our patients are prepared for fever therapy by following a printed instruction sheet, which suggests that they increase their fluid intake by drinking a quart of water and a quart of a special "prefever cocktail" each day for two days preceding their treatment. This so-called "cocktail" consists of:

Salt .....3 level teaspoonsful
Karo syrup.....6 level tablespoonsful
Knox's sparkling gelatin.....1 oz.
Juice of 1 or 2 lemons, 3 or 4 oranges, or ½ cup of beef broth
Water .....1 qt.

Our use of this formula is based on work done by Dr. Milton G. Schmitt of Chicago.

We also suggest that the patient take an enema the evening before treatment. We advise that most patients eat a very light breakfast, and those who are to have intravenous medication, especially the arsenicals, are requested to eat no breakfast on the morning of treatment.

Administration—Our technic of administering inductopyrexia is as follows:

The patient is placed in a cabinet in which the initial environmental temperature of 110 F. is maintained until the patient's temperature has reached the desired height. The humidity in the cabinet is held at 95 to 100 per cent from the beginning to the end of treatment. The purpose of the high humidity, of course, is to prevent the natural cooling of the body by the evaporation of perspiration. A high frequency current is then allowed to pass through a loop of cable, which is placed under the mattress of the cabinet, and this current in turn generates a magnetic field and secondary currents are set up in the body. It is the resistance to the secondary currents which causes a uniform rise in temperature in all tissues of the body which are placed in the magnetic field. This process is allowed to continue until the patient's temperature reaches the desired level, at which time the inductotherm is turned off. At the same time the environmental temperature in the cabinet is allowed to fall to a few degrees below the patient's temperature. In this way it is possible to control the height of fever with great accuracy and maintain any desired height for whatever length of time is deemed best. The patient's temperature, pulse and respiration are recorded every ten minutes until the desired height of fever is attained, at which time the rectal electric indicating thermometer is used. This gives a continuous check until the patient's temperature is allowed to return to normal. This process of induction takes from one and a half to two and a half hours.

During the induction and maintenance of fever, the patient is under the supervision of one or more technicians, and a physician is always within calling distance.

Patients are given fluids freely during treatment, and they are made as comfortable as possible by the application of cool wet cloths to the face and head. A fan is used if desired by the patient.

The patient is given sedatives, if indicated, during the course of induction as well as during the maintenance of fever. Pantopon gr. ⅛ is used for those patients whose restlessness is not controlled by bromides.

Most patients are more comfortable, both during and following treatment, when adrenal cortex is given hypodermically. The changes in biochemistry involved in the use of this drug are now being studied by Dr. Horace B. Davidson and myself.

Length of Treatment and Height of Fever—The height of fever and length of treatment vary widely, depending upon the disease being treated and the patient's tolerance to fever. In most cases the patient's temperature ranges from 105.8 to 107 F. for from one to three hours. In some diseases the temperature does not need to be over 103 to 105. This is especially true for many

arthritic patients. In some diseases, particularly in neurosyphilis, longer treatments are indicated in selected cases.

Condition of Patient After Treatment—Approximately 98 per cent of our patients are able to return to their homes the evening following treatment. Most of these return to their regular employment the following day. As these statements suggest, there is usually only very slight malaise as the result of inductopyrexia. Accordingly, the pulse rate, which during treatment very seldom exceeds 120 beats per minute, usually is normal. The blood pressure may be five to ten points lower, both systolic and diastolic, for several hours after the patient's temperature is normal.

SUMMARY AND CONCLUSION

(1) The use of therapeutic high fever produced by electromagnetic induction is of great value in the treatment of syphilis, undulant fever, gonorrhea, selected cases of arthritis, rheumatic fever and chorea, optic atrophy (syphilitic) and some cases of edema of the retina. Properly selected cases of osteomyelitis, allergy and multiple sclerosis are benefited by this form of treatment. The greatest value of inductopyrexia now is the increased benefit derived from older methods of treatment when combined with fever.

(2) The proper preparation of the patient for treatment is most important.

(3) The administration of fever therapy must be carefully supervised, and great care given to detail.

(4) Improvement in preparation for, and technic of administration of, fever therapy has made it a very safe procedure and has reduced to a minimum the loss of time to the patient for treatment.

(5) Inductopyrexia is a rapidly developing field of therapy for which new uses are constantly being found.

Mobile Unit for Physical Therapy

Lord Horder, president of the Chartered Society of Massage and Medical Gymnastics, presented, on behalf of subscribers, a physical therapy mobile unit, which is complete with its driver and a skilled masseur, for use in Red Cross work. It makes its own electricity for electrical treatment and will be used for visiting convalescent homes and hospitals in central England. The unit contains all the necessary apparatus for giving electrical and light treatments, such as galvanism, infra-red rays, radiant heat, ultraviolet radiation and paraffin-wax baths. The unit is the first of its kind and is to be followed by others.—*From "Foreign Letters," J.A.M.A., May* 17, 1941.

Ethics and the Physical Therapy Technician

Christopher J. McLoughlin, M. D.

Ethics, when discussed from a didactic standpoint, usually is abstruse, tiresome and generally uninteresting. However, so universal is the subject that every word spoken and every deed accomplished is governed by a code of ethics which is built up in the individual through the years to maturity. The composite of this code depends to such an extent on the foundations that a man's ethics may be his fortress or his ruin. No attempt will be made in this paper to establish a new code for anyone; rather, a few points will be stressed which may make the present foundations more secure or repair any weakness or defect in the existing system.

The word ethics is derived from the Greek "ethos," signifying character. As employed in the days of the Romans the term was closely akin to "morals." However, through the centuries there has arisen a distinction between the two, so that at the present time we speak of ethics as the underlying principles of conduct regarding right and wrong. "Morals" today means the outward manifestation of this code of ethics. The two do not always coincide. A man's ethics and ideals may be of the highest; yet his conduct toward his fellow men may be extremely immoral.

These principles governing conduct are not found in any one book, nor have they been propounded by any one man. They are the accumulations of the philosophy of the past thousands of years. The earliest recorded principles of ethics can be found in the works of Budha and Confucius. These foundations have been strengthened and built by the wise men and thinkers throughout the various civilizations of the past. The philosophers of Greece sought to build up these principles by straight thinking. The inspiring Hippocratic oath, the code of the medical profession, has set a standard which no one has been able to improve in more than 2,000 years.

Every person, whether or not he or she realizes it, has a code of ethics. It is this code which enables the individual to live up to the standards of being a lady or a gentleman. Written laws are not necessary. General Robert E. Lee, when he was president of Washington College, was asked for a copy of the rules of that institution. He replied: "We have no printed rules. We have but one rule here, and that is that every student must be a gentleman." Being a lady or a gentleman means corresponding to an ideal which we have set up in our minds, the counterpart of which may or may not exist in real life.

Because the physical therapy technician is associated with the medical profession, her prime objective is the service of humanity. In rendering this service, certain rights and obligations must be assumed. Wherever a right exists, there must also exist an obligation. The technician has obligations to her patient, her superiors and herself. However, whereas the patient may expect certain things from the technician, he is obliged in turn to observe the rights of the technician. We are concerned primarily, then, with the obligations of the technician to these various persons. Her conduct toward these persons constitutes her code of ethics.

Obligations to the Patient

The greatest of the obligations of the technician are to the patient. Anything that is done for the patient must be done only for the welfare and benefit of that patient. There are many things about which one must be particularly careful. In the first place, never consider an invalid as a "case." Each sick person is an individual, and regardless of how similar his disease may be to that of another, personalities and backgrounds are never identical. No two patients react exactly alike to the same thing and "One man's food is another man's poison." Learn to consider patients as individuals, and you will soon learn to think of them as human beings and not as inanimate objects. Always make a point of knowing the name of the patient and how to pronounce it properly. Even though we may not stop to realize it, the sound of our own name, correctly pronounced, bespeaks friendliness and personal interest. Learn, too, the complete diagnosis and the name of the physician in charge of each patient.

Just as patients differ in personality, so it is necessary to use a different manner of approach

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with various types of patients. Learn to evaluate readily the type of personality with which you have to deal, and then adapt yourself to it. Make certain that the patient knows your name and how to pronounce it. This will usually help him to feel that you are rendering a more personal service. Moreover, do not take offense if an elderly man or woman wishes to address you by your first name. First names are usually much easier to remember than surnames; and the use of given names often does much to establish friendship.

Often a smile and a cheery word will encourage a patient; however, all evidence of flippancy should be avoided carefully. The greeting should convey warmth and personal interest rather than the mechanical salutation given to one who is a mere acquaintance. Sense when the patient is inclined to be taciturn and do not bore or annoy him with small talk. Respect his idiosyncrasies whenever they do not interfere with the treatment.

At all times keep your voice well modulated. Many patients will wish to sleep or rest while receiving treatment, and there is nothing more annoying than to hear loud, harsh voices or raucous laughter at such a time.

The soothing effect of the application of heat and massage may make some patients inclined to be communicative, and they are likely to disclose facts which they would not mention under ordinary circumstances. Anything told in confidence must not be divulged. Never attempt to gain a confidence with the object of securing information which is not rightly yours.

Many patients will ply you with questions regarding their condition; but it is not within your province to discuss the prognosis or pathology, particularly if it is discouraging. It is the duty of the physician to decide what amount of information should be given to the patient. If he decides not to inform the patient of his condition, the physician probably will select some responsible member of the family, discuss the true condition with him and also explain the prognosis and any risks which might be encountered in the treatment. Usually, seriously ill patients are not inclined to be talkative about their condition and prefer not to discuss it. Calm reassurance is generally the best method of dealing with the apprehensive patient, and by being tactful you will avoid embarrassing explanations.

Saying to the patient, "Don't worry," will do little to stop his fretting. Without stressing the subject, it often is possible to point out the futility of worry and to lead to the contemplation of more pleasant subjects. Do not inflict your personal problems on the patient. Your own problems will not distract the patient's mind from his illness but often may add to his worries and confusion.

The patient is entitled to as much comfort as his illness will allow and it is your obligation to see that this comfort is provided. The bare necessities should not be deemed sufficient. It takes but a minute to smooth a pillow or see that the patient is covered properly, but it is a considerable factor in making the patient feel that someone is interested in his welfare. Care should be taken to insure the patient against undue exposure to drafts and chilling. Remember that modesty is not a thing of the past and unnecessary exposure of the patient may cause embarrassment. If you are treating a back, a sheet thrown over the legs and hips will give a feeling of being clothed, rather than a sense of nakedness. If you are massaging a leg, be sure to cover the limb which you are not treating, and place the sheet over any part that you have finished massaging.

OBLIGATIONS TO SUPERIORS

Any changes in the condition of the patient should be noted and reported at once to the supervisor. Any abnormal condition or sign of regression should be called to the attention of the physician immediately. A noticeable increase in temperature, pain or swelling should be reported. The technician must also keep a written record of the progress of the patient, including such things as temperature, color and condition of the skin, return of power and freedom of movement, or any other indication of improvement or regression.

Each technician should cooperate in an effort to maintain harmony in the department. Wherever two people work together, differences of opinion will occur. Common sense, a spirit of fairness and a simple application of the golden rule will serve, in almost every case, to keep peace in the department. Dissension among fellow workers is bound to be reflected in the treatment booth, often to the detriment of the patient.

Naturally it is understood that it is against all professional and nonprofessional principles to speak ill of supervisors or other associates. This tends to destroy whatever confidence the patient may have in his medical advisers and tends to undermine the foundations of medical art. Without faith there can be no cure.

The medical profession does not sanction the

use of secret devices for treatment of human ills. The common bond of service to mankind demands that anything beneficial should be shared, and improvements in apparatus, technic and routines should be disseminated to legitimate members of the profession. Only the charlatan claims to have a secret "cure" which he refuses to impart to others. The rewards for disclosing these professional routines are to be found in the satisfaction of doing a good job well. Monetary rewards are negligible.

It is considered unethical, and in some states it is directly contrary to law, for the physical therapy technician to open an establishment for the treatment of patients unless under the direct supervision of a physician. For the technician to prescribe treatment is unethical and dangerous, not only for the patient but for the technician. The physical therapy technician has had neither the training nor the experience necessary for the diagnosis of disease. It is likewise unprofessional to solicit patients for treatment, either directly or indirectly.

OBLIGATIONS TO SELF

Personal cleanliness is an intrinsic requirement for the physical therapy technician. Absolute freedom from bodily odor and a clean and neat appearance are essential. The daily bath should be supplemented with a routine care of the hair, nails, feet and other parts of the body. The hair should be combed and arranged neatly. Extreme "hair-do's" with many curls are as much to be frowned on as uncombed or disarranged hair.

Mascara, eyebrow pencil, eye shadow, rouge and lipstick should be applied with discretion, since an appearance of the artificial or unnatural should be avoided. Restraint should govern the use of cologne and scented cosmetics.

Care of the hands is important. They should be kept smooth, soft and clean. Deep or startling shades of nail polish should not be used and the nails should be filed neatly to the tips of the fingers. Long or pointed nails may catch in the linen or scratch the patient.

The question of smoking is strictly a personal and not an ethical problem. However, it should be remembered that smoking causes an odor which clings to clothing, hair and breath. This is sometimes unpleasant. Hands stained from nicotine are unsightly.

The uniform always should be neat, clean and modest. It should fit well enough to insure neatness and yet loosely enough so that there is not too much accent on physical contours. Stockings should be worn at all times and preferably should be white. They should not be rolled in such a way that the roll shows below the hem of the uniform. The use of white shoes of the Oxford type is recommended. Fancy straps and lacings are out of place and the shoes should be kept in good repair.

No jewelry should be worn, except possibly the insignia of the school from which the technician is a graduate. Not only does jewelry look inappropriate but it tends to become unsanitary. Moreover, it may catch in the linen or may scratch or injure the patient. This applies to rings, in particular.

The fact that you have become established in a position is no reason to consider that your studies are at an end. Never lay aside the pursuit of knowledge. There is hardly a month of the year that does not produce some new development in the science of healing and you owe it to yourself, your superiors and your patients to keep abreast of these advances. Become a member of some physical therapy organization and attend the meetings faithfully. If possible, take part in at least one postgraduate or continuation course each year. Be sure to subscribe to at least one journal which will report the advances in the field. Only in this way can you maintain high professional standards.

A tired mind and body are not conducive to good work. Recreation should play an important part in the life of everyone. An avocation of some sort will provide relaxation for body and spirit. The fields of art, literature, music and science open the doors to countless hours of enjoyment. Pleasure in the arts comes from partaking and not from the art itself. Remember that relaxation is an essential for all who are to maintain health and give to their work the energy that it requires. Recreation is always a highly recommended prescription for the patient and here again, "What's sauce for the goose is sauce for the gander."

On your interpretation of the word "success" will depend your attainment of the goal. To some it means wealth and position; to some independence; to others, happiness and contentment. Success, like time, is a relative thing and can be based only on the standards which you yourself establish. The trained technician has the prerequisites which may be considered essential for its attainment. She has the necessary intelligence, guided and matured through the years by training and education. Lastly, she has character, which is probably the most important requisite. High standards and ideals are not in themselves enough to insure success. However, intelligence, education and character, supported by a good code of ethics, undoubtedly will bring the measure of success so justly deserved.

The
Physiotherapy Review

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We strongly urge that every member read the article on "Ethics and the Physical Therapy Technician" published elsewhere in this issue. Doctor McLoughlin has covered the subject so thoroughly that we have nothing to add. We do feel, in these times of trouble and unrest, that personal integrity is a major and extremely vital asset. Too often the simplest rules of conduct toward our patients, such as being kindly, courteous and considerate, are lost in the more difficult process of carrying out prescribed treatments. Extra services which may seem small and unimportant to the technician may be the cornerstone of the patient's recovery. These same principles apply to our colleagues and superiors. If we have as a personal code of ethics those principles of the Golden Rule we cannot fail to succeed in whatever we attempt to do.

Carolina Chapter

The Carolina Chapter held its first annual meeting at Fort Bragg, North Carolina, April 26 and 27, 1941. A paper on "Physical Therapy in the Army and the Recent Expansion Program at Fort Bragg" was presented by Brig. General Harry C. Coburn, Commanding Officer of the Fort Bragg Medical Center. Another paper entitled "Early Physical Therapy in the Army" was presented by Lt. Col. P. C. Riley, Attending Surgeon at Fort Bragg, who also is a member of the Advisory Council of the Carolina Chapter.

On the second day of the meeting, Lt. Col. G. D. Chunn, Commanding Officer of the large cantonment hospital recently constructed at the Fort, conducted a tour of the hospital, and Lt. Col. P. L. Cook, Chief of the Surgical Service, presented case studies of patients under treatment in the physical therapy clinic.

Miss Alice Lou Plastridge, of the Warm Springs Foundation, attended the meeting and spoke to the members at their business meeting.

District of Columbia

A dinner meeting was held April 19, 1941, at the Iron Gate in honor of Miss Helen Kaiser, of Cleveland, who gave a short talk stressing registration with the Red Cross. Fifteen members from the Maryland Chapter joined in this meeting.

Ohio Chapter

The Ohio State Chapter meeting was held in Columbus, Ohio, April 30, and May 1, 1941.

National Foundation for Infantile Paralysis

In order to render assistance locally during epidemic periods the National Foundation for Infantile Paralysis has had manufactured a supply of Toronto splints and Bradford frames designed for use in the acute stages of infantile paralysis. The Foundation has made this equipment available to any community for use during epidemics or to those indigent infantile paralysis patients who need them. The appliances are furnished through County Chapters of the Foundation or other agencies who are expected to bear any expense incidental to the transportation or distribution of the equipment.

Correction

In the May-June 1941 issue, page 152, the list of "Schools for Physical Therapy Technicians" failed to include the following school approved for training physical therapy technicians: Stanford University, Stanford University, California; entrance requirement—(a) R. N., (b) Grad. Phys. Educ., (c) 2 years college; length of course—12 months and 4 years; student capacity—6; tuition—University fees; certificate, diploma or degree—certificate or B.A. W. H. Northway, M. D., is the medical director of the course.

Twentieth Annual Conference of the American Physiotherapy Association

Lagunita Court, Stanford University, California, June 13-18, 1941

GENERAL INFORMATION

COMMERCIAL AND EDUCATIONAL EXHIBITS

You are urged to visit the exhibits. There is much of value and interest in them.

Movies will be shown Tuesday and Thursday afternoon at 4:30 in the conference room, Lagunita Court.

REGISTRATION

Sunday, July 13, from 3 to 6 P.M., in the foyer of Lagunita Court; July 14 to 18, in the conference room of Lagunita Court.

FEES

Room, three meals per day (July 13, dinner, through July 18, luncheon), and registration, for members, $20.75; for nonmembers, $21.75 including tax and tips. Reservations must be made by July 1.

For those not attending the entire convention or living away from Lagunita Court:

Registration fee (members)	$1.00
Registration fee (nonmembers)	$2.00

NOTE: People desiring the following types of accommodations should notify the A.P.A. office by July 1, giving actual dates, in order that arrangements may be made. Prices include tax and tips.

Room, per night, at Lagunita Court	$ 1.50
Dinner, Sunday night (July 13)	1.30
Supper, Allied Arts, Thursday night (July 17)	1.10
Rate for luncheons and dinners (including Sunday night and Allied Arts, Thursday)	10.75
Breakfast may be obtained at a complete price range at the Stanford Union	
Rate for luncheons, July 14 through July 18	4.00
Rate for dinners, July 13 through July 17	6.75

If you wish to attend the conference Saturday morning, July 19, from 9:00 to 12:00, on the survey which is to be made on Physical Therapy in Poliomyelitis, kindly indicate this on your reservation blank.

RECREATION

The swimming pool will be open to conference guests from 4:30 to 5:30 P.M. Monday through Thursday. Suits are provided for women. The University does not own men's suits, and we suggest men bring their own. Conference guests may use the golf course at student rates by presenting their conference registration cards. Four tennis courts close to Lagunita Court are available.

PROGRAM

All meetings in Lagunita Court unless otherwise designated.

GOVERNING BOARD MEETINGS (for members of Governing Board and National Committee Chairmen)

Saturday, July 12—1:00 to 5:00 P.M.
8:00 to 10:00 P.M.
Sunday, July 13— 9:00 to 12:00 A.M.
Friday, June 18— 1:30 to 3:30 P.M.

SUNDAY, July 13

3:00 P.M.—Registration

6:30 P.M.—Dinner

Presiding — CATHERINE WORTHINGHAM, President, American Physiotherapy Association

Welcome—M. CAROLINE WELLS, President, Northern California Chapter, American Physiotherapy Association

Speaker—WILLIAM DEKLEINE, M.D., American Red Cross; "The Need of Physiotherapists in the Army and Navy"

MONDAY THROUGH THURSDAY

Discussion groups. (See page 208 for detailed program.)

FRIDAY, July 18

8:00 A.M. "Recent Studies in the Treatment of Poliomyelitis in the Acute and Convalescent Stages"—Round Table Discussion

Chairman, SARA E. KOLLMAN, University Hospital, Minneapolis, Minnesota

1) "Comparative Study of the Treatment of Poliomyelitis," DOROTHY BAETHKE, Dowling School for Crippled Children, Minneapolis, Minnesota

2) "Symptoms and Treatment in the Acute Stage of Poliomyelitis," LILLIAN HUBMER, Curative Workshop, Minneapolis, Minnesota

3) "Exercises during Convalescent Stage of Poliomyelitis," MARIAN DENNY, Gillette State Hospital for Crippled Children, St. Paul, Minnesota

10:00 A.M. to 12:00 M. Business Meeting

2:00 P.M. Trip to San Francisco

Arranged by members of Northern California Chapter

SATURDAY, July 19

9:00 A.M. to 12:00 M. Conference on the Survey to be Made by the American Physiotherapy Association on Physical Therapy in Poliomyelitis

Schedule for Conference, Monday Through Thursday

MONDAY, July 14	TUESDAY, July 15	WEDNESDAY, July 16	THURSDAY, July 17
A.M.			
7:15 Breakfast	Breakfast	Breakfast	Breakfast
8:00 Muscle Testing	Muscle Testing	Muscle Testing	Muscle Testing
9:30 Therapeutic Gymnastics	Therapeutic Gymnastics	Therapeutic Gymnastics	Therapeutic Gymnastics
11:00 Psychology of the Invalid and Handicapped	Psychology of the Invalid and Handicapped	Psychology of the Invalid and Handicapped	Psychology of the Invalid and Handicapped
P.M.			
12:15 Luncheon Stanford Union	Luncheon Stanford Union	Luncheon Stanford Union	Luncheon Stanford Union
1:30 Selection and Evaluation of Heat Therapy Equipment	Selection and Evaluation of Heat Therapy Equipment	Selection and Evaluation of Heat Therapy Equipment	Selection and Evaluation of Heat Therapy Equipment
3:00 Skeletal Muscle and Motor Activity in Health and Disease	Skeletal Muscle and Motor Activity in Health and Disease	Skeletal Muscle and Motor Activity in Health and Disease	Skeletal Muscle and Motor Activity in Health and Disease
4:30 1) Problems of Crippled Children's Schools 2) Problems of Physical Therapy Schools	Movies Visit Exhibits	1) Problems of Crippled Children's Schools 2) Problems of Physical Therapy Schools	Movies Visit Exhibits
6:15 Dinner Hour	Dinner Hour Meeting of Northern California, Southern California and Santa Barbara Chapters on State organization and legislation Presiding, VIRGINIA UTZ	Dinner Hour Chapter Problems Presiding, EVELYN ANDERSON	Allied Arts Supper Hostess—Northern California Chapter
7:30 Business Meeting			

DISCUSSION GROUP PROGRAMS

MONDAY THROUGH THURSDAY,
July 14 through 17

8:00 A.M. MUSCLE TESTING

Chairman, ALICE LOU PLASTRIDGE, Director of Physical Therapy, Warm Springs Foundation, Georgia

Consultants, CHARLES H. DANFORTH, Professor of Anatomy, Stanford University
VERNE T. INMAN, Instructor in Anatomy and Orthopaedic Surgery, University of California, San Francisco

Monday *Tests for Lower Extremity.* Consideration of the action of two-joint muscles. Positions, movements, types of resistance, for old and new cases

SIGNE BRUNNSTROM, Instructor in Education, New York University, New York City
EMMA SCHRAMPF, New York Orthopaedic Hospital, New York City
MILDRED EVANS, Director of Physical Therapy for F. R. Ober, M.D., and B. A. Wellesley, M.D., Boston, Massachusetts

Tuesday *Tests for Shoulder Muscles.* Positions, movements, types of resistance—new and old cases

GRACE L. WILLIAMS, Director of Physical Therapy Department, Children's Hospital Society, Los Angeles

Wednesday *Tests for Trunk Muscles.* Anterior and lateral abdominals and back. Strong, extremely weak, asymmetrical

SUSAN G. ROEN, Orthopaedic Hospital School, Los Angeles
HENRY O. KENDALL, Director of Physical Therapy, Children's Hospital School, Baltimore, Maryland
MRS. ELIZABETH THOMSON, Head of Physical Therapy Department, Junior League Home for Crippled Children, Nashville, Tennessee; Instructor, George Peabody College for Teachers, Nashville, Tennessee

Thursday *Charts.* Classification and systems for recording
IRMA J. WALKER, Spalding School for Crippled Children, Chicago
ESTHER GILLETTE, Supervisor of Physical Therapy, Association for Crippled and Disabled, Cleveland, Ohio
MARJORIE DENNEN, Merritt Hospital, Oakland
MARGARET CAMPBELL WINTERS, Chief Physiotherapist, University of Chicago Clinics, Chicago
MILDRED ELSON, Office of Emil Hauser, M.D., Chicago
PAULA BLACKMAN, Supervisor of Physical Therapy Department, Hospital for Joint Diseases, New York City

9:30 A.M. THERAPEUTIC GYMNASTICS
Chairman, CATHERINE WORTHINGHAM, Director of Physical Therapy, School of Health, Stanford University
Consultant, CHARLES L. LOWMAN, M.D., Chief of Staff, Orthopaedic Hospital School, Los Angeles

Monday *Progressions for Lower Extremity* (Difficulty and Force)
MARGO CRAIN, Graduate Student, Stanford University
CATHERINE WORTHINGHAM
Progressions for Lower Back and Abdominal Muscles (Difficulty and Force)
EDITH LINDSAY, Assistant Professor of Physical Education, Mills College, California
MRS. MARGERY WAGNER, Physical Therapy Department, University of California Hospital, San Francisco
Discussion

Tuesday *Progressions for Upper Extremity* (Difficulty and Force)
MABLE WARD, Chief Technician, Santa Barbara Clinic, Santa Barbara, California
MRS. HELEN FIVASH, Chief Physiotherapist, Children's Hospital, San Francisco
Dosage
LUCILE GRUNEWALD, Assistant Supervisor of Physical Education, University of California at Los Angeles
Discussion

Wednesday *The Relation of Short Muscle Groups to Body Mechanics*
CLIFFORD SWEET, M.D., Chief of Staff, Children's Hospital of the East Bay, Oakland, California
Demonstration of Stretching Techniques
MARGARET E. JEWELL, Assistant Professor of Physical Education, Stanford University
Discussion

Thursday *Carry-overs from Exercise into Practical Use*
MARGARET CAMPBELL WINTERS, Chief Physiotherapist, University of Chicago Clinics, Chicago
MILDRED ELSON, Office of Emil Hauser, M.D., Chicago

11:00 A.M. PSYCHOLOGY OF THE INVALID AND THE HANDICAPPED
HERMAN CHOR, M.D., Associate, Department of Nervous and Mental Diseases, Northwestern University, Chicago

1:30 P.M. SELECTION AND EVALUATION OF EQUIPMENT IN HEAT THERAPY
Chairman, HAZEL FURSCOTT, San Francisco
Consultant, FRANCIS BAKER, M.D., Instructor in Orthopedic Surgery and Director of Physical Therapy, University of California, San Francisco
PURPOSE: To discuss a scientific basis for selecting a form of physical therapy to produce hyperemia and an attempt to answer the following questions:
1) What are the conditions where one method has been proved to have clinical superiority over another or to have specific effect?
2) What are the conditions in which the simpler and easier modes of application prove as effective as the more elaborate methods?

Monday *Outline of Physics of Cold, Heat, and Electricity*
R. R. NEWELL, M.D., Professor of Medicine (Radiology), Stanford University Hospitals, San Francisco
Equipment Study
DOROTHY YOUNG, Palo Alto, California

Tuesday *Discussion of Physiology of Heat*
MRS. MARGARET CLEAVELAND, Chief Physiotherapist, The University Hospitals of Cleveland, Cleveland, Ohio
Report of Recent Experimental Work Done in Relation to the Physiology of Heat
GERTRUDE BEARD, Associate in Physical Therapy, Northwestern University Medical School, Chicago

Wednesday *Discussion of the Pathology of the Most Common Conditions Treated by Heat*
MRS. HARRIET LEE, St. Joseph's Hospital, Denver

Thursday *Evaluation and Comparison of Methods Other than Heat in Use for the Same Conditions*
FRANCES BAKER, M.D.
Conclusions from the Above Discussions for the Selection and Evaluation of Equipment in Heat Therapy
MRS. MARGARET CLEAVELAND
Reference Reading List MARY MACKAY, Stanford University Hospitals, San Francisco

3:00 P.M. SKELETAL MUSCLE AND MOTOR ACTIVITY IN HEALTH AND DISEASE
HERMAN CHOR, M.D., Associate, Department of Nervous and Mental Diseases, Northwestern University, Chicago

4:30 P.M. PROBLEMS OF CRIPPLED CHILDREN'S SCHOOLS
Chairman, EMILY ADAMS, Oakman School, Detroit

Monday *Problems of Organization within the School.* The department: location and equipment, policies, records, schedules; cooperation of the physical therapist with other members of the school staff, with school nurses and school physicians.

Discussion leaders:

DOROTHY E. BAETHKE, Dowling School for Crippled Children, Minneapolis, Minnesota

ALICE V. GOODMAN, Sunshine School, San Francisco

IRMA I. WALKER, Spalding School, Chicago

FAE HENRY, Orthopedic School, Sheboygan, Wisconsin

Wednesday *Problems of Cooperation with Agencies, Organizations, and Individuals Outside the School.* The relation of the school physical therapist to parents, guardians, the medical profession, state and local programs, hospitals, convalescent homes and lay organizations caring for the crippled child.

Discussion leaders:

LAURA B. BORWELL, Orthopedic School, Madison, Wisconsin

HELEN S. FOSS, Children's Hospital, Iowa City, Iowa

NELLIE HAGAMAN, Bushnell School, Springfield, Ohio

GERALDINE LARSON, Crippled Children's Division, State Department of Public Welfare, Little Rock, Arkansas

4:30 P.M. PROBLEMS OF PHYSICAL THERAPY SCHOOLS

Chairman, SUSAN G. ROEN, Director of Physical Therapy, Orthopaedic Hospital School, Los Angeles

Monday 1. *Discussion of Possible Revision of the Present Minimum Curriculum*

CONSTANCE K. GREENE, Instructor, Bouvé-Boston School of Physical Education, Boston

LILY H. GRAHAM, Director, School of Physical Therapy, Los Angeles Children's Hospital, Los Angeles

2. *Discussion of Entrance Requirements*

WILLIAM H. NORTHWAY, M.D., Director of Physical Therapy, Stanford University Hospitals; Assistant Professor of Medicine, Stanford University Medical School, San Francisco

LUCY MARSHALL, Director of Physical Therapy, Posse Institute, Kendal Green, Massachusetts

3. *Discussion of Course Content in Relation to Differences in Basic Education*

GERTRUDE BEARD, Associate in Physical Therapy, Northwestern University Medical School, Chicago

EVELYN ANDERSON, Supervisor of Physical Therapy Technicians, Stanford University Medical School; Chief Physical Therapy Technician, Stanford University Hospitals, San Francisco

Wednesday *What Effect Will the Emergency Courses Have on the Future Educational Standards of Physical Therapy Schools?*

GERTRUDE BEARD — CONSTANCE K. GREENE
LILY H. GRAHAM — WILLIAM H. NORTHWAY, M.D.

Index to Current Literature

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Amputation in Congenital and Chronic Disabilities. Council on Physical Therapy, J.A.M.A., May 10, 1941.

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ABSTRACTS

John S. Coulter, M.D.

Physical Fitness in Terms of Physique, Development and Basal Metabolism with a Guide to Individual Progress from Infancy to Maturity: A New Method for Evaluation

Norman C. Wetzel, M. D. In J.A.M.A., 116:12:1187, March 22, 1941.

A new method for evaluating physical fitness, based on the use of a grid to aid in this purpose, is described in this paper.

To establish a grid rating of physical condition, only three traditional measurements (weight, height and age) are required. When these are plotted on the grid, direct estimates of physique (body build), developmental level, nutritional grade, physical status and relative age advancement are obtained independently of one another. For successive annual or semiannual observations a record is built up which shows how satisfactory progress has been in the past and also indicates what forthcoming progress may be expected in the near and more distant future.

The author's grid consists of seven principal channels, the axes of which, taken crosswise, cover a range of physique (body build) from the obese to the extremely slender type and, channelwise, a range of development from infancy to maturity. The paths are linear during school life.

According to Wetzel, healthy developmental progress continues in an established channel as though this were a preferred path; channel width accounts for accidental variation which does not exceed one-half channel per 10 units of advancement. Channelwise progress indicates development with preservation of given physique; cross channel progress is accompanied by change in physique. The latter type, sufficiently continued, culminates in a pathologic state. An upward trend greater than that of the channel slope indicates that obesity is in the making; a downward trend less than that of the channel system suggests that "malnutrition" is not far removed. The slope or gradient of the developmental curve gives a simple and direct measure of what clinicians, in assessing physical fitness, call the state of nutrition. Optimum nutrition, overnutrition and undernutrition are presumptively indicated by zero, positive and negative departures, respectively, from the channel slope.

Physical status is the attribute which results from the combined effects of growth, development and nutrition cumulated to the moment in question. Six ratings are tabulated to identify subjects in the obese, stocky, good, fair, borderline and poor groups. Standard schedules of developmental progress are given which show how far the physically advanced, regular or retarded child may be expected to have developed at a given age. Average progress is approximately one level line a month. Values much greater or less than this are unsatisfactory, even though development is proceeding strictly at the channel slope.

New standards of basal heat production are included which enable estimates of metabolism to be made, without further correction, from the developmental level attained by a given subject. The heat production scale in conjunction with developmental levels also provides a ready estimate of the daily caloric intake required in regular and special diets.

By actual test, grid ratings of physical fitness on 2,093 school children have been compared by the author with physicians' estimates. Agreement reached 94 per cent for all children except those in the B_2 (fair) channel, on whom physicians find it difficult to agree among themselves. The grid, moreover, caught 94.5 per cent of the subjects called "poor" or "borderline" by the physicians. Today approximately 30 per cent of all children are in need of more than routine checkup. The screening and identification of these particular children are greatly facilitated and reliably performed by simple inspection of their grid records. But final judgment on their physical fitness rests with the physician, who can take both the grid and the clinical results into joint account.

Short Wave Diathermy—Power Absorption and Deep Tissue Temperature

E. Mittelmann, E.E., Ph.D., S. L. Osborne, Ph.D. and J. S. Coulter, M.D. In Arch. P. T., 22:3:133, March 1941.

These authors conclude that:

1. Measurements of power absorption were made with a high frequency wattmeter with an average accuracy of plus or minus 5 per cent.

2. It was found that the temperature rise in the deep tissues per minute was proportional to the number of watts indicated by the instrument.

3. Temperature rise is linear for wattages below 100 watts of power absorbed. Wattages above 100 watts, however, produced a nonuniform rise toward the end of the treatment, probably due to the marked increase of blood flow. Therefore with high wattages the final temperature attained at the end of a twenty minute period is not a true measure of the machine's heating ability.

4. The average value of useful power for local application was between 50 to 80 watts.

5. Measurements indicated that 150 to 160 watts was the maximum power which can be utilized by human tissues. This amount of power was sufficient for effective fever therapy.

6. The useful power or that absorbed by the patient is but a fraction of the total output of the machine as measured by lamp load. There is no justification for the use of generators yielding more than 200 watts of useful power. The ratio between total and useful power is dependent upon machine design and technic of application.

7. The effectiveness of tissue heating in vivo is independent of wavelength.

Calcification of the Supraspinatus Tendon

G. F. Dick, M. D.; L. W. Hunt, M. D., and J. L. Ferry, M. D. In J.A.M.A., 116:12:1202, March 22, 1941.

According to the authors calcification in the supraspinatus tendon is a relatively common cause of pain and limitation of motion of the shoulder, occurring in adults of all ages, although it is most frequently found between the ages of 30 and 45.

Apparently the deposit of lime salts occurs quietly and precedes by a considerable interval the onset of clinical symptoms. The onset may be either gradual or acute. In either case most patients complain of pain in the region of the apex of the shoulder joint occasionally radiating down the anterior aspect of the arm or to the side of the neck.

The contour of the shoulder joint usually shows little change, although there occasionally is slight atrophy of the muscles.

On roentgen examination the calcareous deposits cast a shadow of varying density. The shadow may be thin and hazy or dense as bone.

The management of patients with calcification of the supraspinatus tendon is largely dependent on whether the condition is acute or chronic. Until recent years the best treatment in the acute stage was considered by many, especially surgeons, to be surgical excision of the calcified material. That this procedure is questionable in the majority of patients is evidenced by the excellent results obtained by medical management.

The treatment that the authors have used with good results during the past few years consists of (1) relatively large doses of ammonium chloride, (2) rest of the diseased part, (3) physical therapy and (4) elimination of foci of infection. The ammonium chloride is given in doses of 1 Gm. or more four times a day. If given after meals it seldom causes gastric discomfort. If it should, enteric coated tablets are available. The purpose of the ammonium chloride is to produce mild acidosis which tends to absorb deposits and acts somewhat similarly to the process of deleading in chronic lead poisoning.

Rest of the diseased part is important. Some physicians endeavor to obtain rest of the diseased part by holding the arm at a 120 degree angle on various forms of splints or plaster casts or by tying the wrist to the head of the bed. Such positions are rather uncomfortable, and patients are prone to consider such treatment worse than the disease. Proper rest of the diseased part can usually be obtained during the day by a properly applied sling, and at night a 40 to 60 degree angle of abduction can be obtained by resting the arm and forearm on a pillow.

Physical therapy in its various forms is helpful but if used injudiciously may cause an aggravation of symptoms. Diathermy is probably the best form of physical therapy in this condition, but if it is not available or expense prohibits its use, an infra-red lamp for thirty minutes two or three times a day is a good substitute. Gentle massage combats the tendency to atrophy and may aid in the relief of pain, but it should not be employed directly over the tender area.

Careful search for foci of infection should be made and proper treatment given.

Present Status of Ultraviolet Irradiation
Frank H. Krusen, M. D. In Arch. P. T., April 1941.

The evaluation of ultraviolet radiation in medicine is one of the most difficult problems in radiometry. Part of the difficulty results from the fact that the band of wavelengths that have healing power has not been definitely established. Practically the only definite knowledge we have is that ultraviolet wavelengths shorter than about 315 millimicrons have the power of preventing and curing rickets and of activating foods and oils (for example, ergosterol) which, in turn, have the power of curing or preventing rickets when fed to growing animals deprived of ultraviolet solar radiation. Krusen discusses the various effects of ultraviolet irradiation in this article.

Effects on the Skin.—The initial erythematous reaction of the skin after ultraviolet irradiation is generally crisis-like in form, but also may be plateau-like or double crisis-like. The course of the erythema is rhythmic or wave-like in nature and persists over a period of weeks.

Ultraviolet irradiation may be used as a readily controlled method of applying counterirritation to the skin.

Effects on the Eye.—Inflammation of the eye produced by ultraviolet rays does not appear until six to eighteen hours after exposure. Vision is not affected but there is temporary impairment of accommodation and severe deeply seated pain. The pain and headache may last for many weeks and the vision may be blurred when close work is attempted.

Ultraviolet radiant energy is of definite value in treatment for certain ophthalmologic diseases.

Effects on the Blood.—A summary of opinions based on the literature would indicate that irradiation with sunlight or artificial sunlight is followed by an increase in the number of erythrocytes, leukocytes, blood platelets and in the concentration of hemoglobin and in a decrease in the hydrogen ion concentration, coagulation time, and eventually in blood volume, whereas, in general, darkness seems to cause the reverse, with the exception that the blood volume seems also to be diminished.

Favorable results may be obtained in treatment for primary and secondary anemias by heliotherapy, although it is admittedly merely an adjunct.

Effects on the Blood Pressure.—When a single erythema-producing dose of carbon radiation is administered to dogs, the outstanding effect is a diminution of both blood pressure and cardiac output. Among normal men, the blood pressure shows a slight lowering (5 mm. of mercury, systolic and 8 mm., diastolic), which lasts one to two days and is accompanied by an average increase of 21 per cent in cardiac output. In the presence of hypertension, there is a consistent and more extreme degree of lowering particularly of the systolic blood pressure, the average drop being 17 mm. of mercury for the systolic and 7 mm. for the diastolic pressure. The cardiac output was generally increased.

The vasodilation produced by irradiation is considered by some to be limited to the cutaneous region, whereas others believe that such vasodilation extends to the internal vessels as well.

It has been suggested that several factors are responsible for such lowering of blood pressure: (1) the production of cutaneous hyperemia, (2) decrease in viscosity of the blood, (3) production, in the skin, of depressor substances which, getting into the blood stream, lower peripheral resistance, (4) breathing of depressor substances (when artificial sources are used), such as oxides of nitrogen and similar compounds set free by the arc, and (5), sympathetic hypotonia.

Experimental and clinical studies have shown that, particularly in the presence of pre-existing hypertension, massive irradiation with a carbon arc lamp produces some lowering of blood pressure.

Effects on Muscles.—A number of clinical investigators have noted that ultraviolet irradiation produces a remarkable improvement in the tone of unused muscles.

Effects on General Metabolism.—Small doses of ultraviolet radiation stimulate the endocrine system whereas large doses produce a protein shock reaction.

Effects on Fat Metabolism.—Irradiation with the quartz mercury vapor lamp may double the fat content of the blood, may increase the blood cholesterol by 30 per cent and decrease the fat-splitting ferment of the blood. Increases as great as 15 to 43 per cent in blood cholesterol may occur following a few minutes of ultraviolet irradiation, the increase reaching a maximum soon after irradiation and subsiding completely in approximately ninety-six hours. Increases in the blood cholesterol of tuberculous patients have been reported following irradiation with a quartz mercury vapor lamp.

Effects on Calcium and Phosphorus Metabolism.—Although the exact reason why ultraviolet radiation affects the absorption of calcium and phosphorus has not been clearly determined, we do know that it plays an important part in the

promotion of intestinal absorption of these substances. Following ingestion of cod liver oil or exposure to radiant energy, there is an increased assimilation of calcium. It has been suggested that, as physical agents, the ultraviolet rays act synergistically with the parathyroid glands, and that stimulation of the incretory functions of the skin results in the production of viosterol which influences calcium metabolism, if not at the same level as the parathyroid hormone, at all events in parallel with it.

As far as the effects on the retention of calcium and phosphorus are concerned, the actions of cod liver oil and of ultraviolet rays are interchangeable, but all of the physiologic effects of these two agents are not interchangeable. Cod liver oil has much less general beneficial action than ultraviolet rays; the latter produce more general improvement in the activity, muscular tone and contentment of rachitic infants.

Anatomic Diagnosis of Injuries of the Hand

James M. Winfield, M. D. In J.A.M.A., 116:13:1367, March 29, 1941.

"In testing for integrity of the median nerve, it is well to remember that there are five muscles in the hand supplied by this nerve. These muscles are abductor pollicis brevis, flexor pollicis brevis, opponens pollicis and the first and second lumbricals (radial lumbricals). Three of these affect chiefly the functions of the thumb. A branch of the median nerve called the motor or recurrent branch comes off 1-¼ inches (3 cm.) directly distal to a point at which the upper border of the anterior annular ligament crosses the tubercle of the os scaphoides. This branch supplies the three thenar muscles of the thumb. It is superficial and is not well protected; consequently a small laceration in this region may easily damage this nerve. The power of abduction of the thumb, medial rotation of the metacarpal and some flexion at the metacarpophalangeal joint will thus be lost.

The best test for the integrity of the median nerve is as follows: With the palm facing upward, the patient should lift the thumb directly toward the ceiling. This demonstrates the action of the abductor pollicis brevis. It seems to be a more definite test than having the thumb moved across the palm, as the action of the opponens pollicis may be confused with that of the adductor, the latter being supplied by the ulnar nerve. In general, it may be stated that if a patient is able to abduct and rotate the thumb to oppose the fingers the median nerve is intact. Laceration of the median nerve also will produce anesthesia in the area of its distribution (roughly, in three and one-half fingers and the adjacent palm and, dorsally, in the thumb and in the distal third of two and one-half fingers.)

"The ulnar nerve supplies all the short muscles of the hand except those mentioned previously, which are supplied by the median. The action of the interosseus muscles is to abduct and adduct the fingers away from and toward the midline of the hand. Division of the ulnar nerve will produce an inability to perform these movements. The best demonstration, then, of function of the ulnar nerve is to test the action of the interosseus muscles.

"If the fingers are partly flexed, this action may be stimulated by the long extensors, which are supplied by the radial nerve. Anesthesia should also be tested for in the area of the sensory distribution of the ulnar nerve—namely, in the fifth finger and in one half of the ulnar side of the fourth finger and the adjacent palm and dorsum of the hand.

"The radial nerve supplies no muscles in the hand, nor can the motor portion of this nerve be injured below the lower portion of the forearm."

The Rate of Healing of Tendons: An Experimental Study of Tensile Strength

Michael L. Mason, M. D., and Harvey S. Allen, M. D. In Annals of Surg., 113:3:424, March 1941.

The problem of tendon healing and the various factors which affect it are still quite unsettled. Despite a great number of experimental and histologic studies which have appeared during the past 30 or more years, there is still lack of agreement concerning even the tissues which take part in the process.

Three tissues may take part in tendon repair—the tendon itself, the connective tissue in and on the surface of the tendon, and the connective tissue surrounding it. Various other cellular elements enter into the process, but the three mentioned are the important ones. Great difference of opinion exists, however, as to the part played by these various tissues in repair. A few, like the authors, have concluded that both the connective tissues in and about the tendon and the tendon itself take part in the process and that both are important.

Mason and Allen conclude:

(1) Tendon healing as measured by its tensile strength exhibits three phases:

A. Phase of rapid diminution, which lasts about five days.

B. Phase of increase in tensile strength up to a plateau, which it reaches about the sixteenth day.
C. Second phase of increase in tensile strength, which probably starts between the nineteenth and twenty-first day and continues for an undetermined period of time.

(2) Curves of tensile strength conform to phases observed in histologic process of repair:

A. Phase of exudation and fibrinous union.
B. Phase of fibroplasia.
C. Phase of maturation or organizing differentiation.

(3) Function to which the healing tendon is subjected is directly reflected in the curve of the third phase of healing. During the first and second phases it produces no effect unless it is so great as to cause marked separation. During the third phase of healing function accelerates the curve.

(4) Function and motion during the first two phases of healing lead to increased reaction and to separation at the suture line. Restricted use of the tendon, started on about the fourteenth day and continued for one week, or preferably two, may be expected to lead to only a slight increase in reaction and to a rapid increase in tensile strength of the union. Active unguarded use even after three weeks of immobilization may be associated with stretching of the suture line and always leads to increase in reaction.

(5) The holding power of tendon for the suture shows a marked drop below its original power and does not begin to rise until the fifth day after suture. It does not rise consistently above the strength of the sutures until the fourteenth day. Although the strength of union for the first nine days is essentially due to the suture, it is not so great as the immediate sutured strength until after 14 days. The importance of adequate relaxation during this time is evident.

Use of Digitalis to Prevent Exaggerated Acceleration of the Heart During Physical Exercise in Patients with Auricular Fibrillation

Walter Modell, M. D., Harry Gold, M. D., and Harold H. Rothendler, M. D. In J.A.M.A., 116:20:2241, March 17, 1941.

It is well known that patients with heart disease, and especially those with auricular fibrillation, frequently show an exaggerated response to exercise. But whether this response to exercise by these patients is mediated through decreased vagal tone or through some other factor such as stimulation of the accelerators is not established. The authors' experiments indicate that in the average patient with auricular fibrillation with or without digitalis the acceleration of the heart with severe physical exercise is due to decreased vagal tone, the normal mechanism seen in the dog.

This deduction is based on the observation that the maximum rate of the heart beat reached when the vagi are blocked by atropine in the patient with auricular fibrillation is the same as that attained during extreme grades of physical effort. When the degree of digitalization has been relatively light ("vagal" slowing), blocking the vagus with atropine as well as physical exertion produces marked acceleration of the ventricular rate to levels of the order of 150 a minute or more. When the doses of digitalis have been relatively larger ("extravagal" slowing), however, neither blocking the vagi by atropine nor physical exertion produces marked ventricular acceleration, usually not much above 100 a minute.

The type of cardiac slowing by digitalis in auricular fibrillation, whether by the "vagal" or by the "extravagal" mechanism, can therefore be ascertained either by blocking the vagus with atropine or by physical exertion. The two generally yield the same results. If a patient has been digitalized at complete rest in bed, and the ventricular rate has been reduced, for instance, to 70 a minute, the observation that 2 mg. of atropine sulfate injected intravenously fails to accelerate the rate appreciably above 100 beats a minute is, in the average case, a satisfactory indication that the exaggerated acceleration usually seen in patients with auricular fibrillation during physical effort will not occur.

While in the average patient with auricular fibrillation acceleration of the ventricular rate during exercise takes place by a decrease of vagal tone, the results of our studies showed some exceptions. In a few instances the level of the ventricular rate after physical exercise was lower than after complete blocking of the vagi. These probably indicate that the patient discontinued the effort before vagal tone was completely lost. In 4 cases, however, the ventricular rate rose to a level higher than could be accounted for by the complete blocking of the vagus. This indicates that under certain conditions the patient with auricular fibrillation may utilize some mechanism for acceleration of the ventricle during physical effort in addition to the decrease of the vagal tone.

Diathermy in the Home

Editorials, abstract in J.A.M.A., 116:14:1527, April 5, 1941.

Diathermy for use in the home has been extravagantly promoted by various agencies. THE JOURNAL has emphasized repeatedly that any kind of self treatment without scientific diagnosis may be hazardous because it permits neglect of serious conditions that may require professional attention. In several cities, firms have come into being practically overnight, advertised in the daily papers, broadcast over the radio, released high pressure salesmen to sell or rent their products; then they have suddenly disappeared, although in some instances the promoters have appeared in the same role in new firms which repeated this program. Some of these instruments promulgated to the public have been efficient, others have not! Apparatus for diathermy should have sufficient output to heat the tissues, since heat is the only therapy it provides for which critical evidence is available. If the instrument is efficient, it may be dangerous unless its use is supervised by a trained observer. If the machine is inefficient and of low power output, it will not heat the tissues and will be without therapeutic effect.

Recently the Federal Trade Commission has modified a cease and desist order which it issued last November against the Home Diathermy Company, Inc., New York, directing cessation of misleading representations in the sale of a "home diathermy" device. "The modified order directs the respondent to cease and desist from misrepresentation of the therapeutic value and merit of its product, as did the original order," but in the modified order, now in effect, "the respondent is directed to cease disseminating advertisements which fail 'to conspicuously reveal that the device may be safely used only after a competent medical authority has determined, as a result of diagnosis, that diathermy is indicated and has prescribed the frequency and amount of application of such diathermy treatments and the user has been adequately instructed in the method of operating such device by a trained technician'."

If a physician believes diathermy is indicated, he may prescribe for his patient an efficient apparatus which is accepted by the Council on Physical Therapy. The Council found the Home Diathermy Machine not acceptable and published a report in THE JOURNAL, March 20, 1937, page 973. The decision of the Federal Trade Commission helps solve this problem.

The Federal Communications Commission has been cooperating with the medical profession and the manufacturers of electrical therapeutic equipment in the development of a practical way to suppress interferences with the radio. In some instances complaints of interference have been traced to home-operated diathermy machines. The extent to which the medical profession is being held responsible for interference which is in fact caused by home diathermy equipment is not known.

Rheumatic Myalgias

Michael G. Good, M. D. In Practitioner, CXLVI:3:167, March 1941.

Non-articular rheumatism is mentioned in most textbooks, just in passing, under the heading of fibrositis, which is supposed to be "a suitable designation for changes which apparently are very largely in the white fibrous tissues, consequently the tendons, muscles and nerve sheaths, periosteum, various fascia and the fibrous portions of the ligaments are involved."

Rheumatic myalgia is a muscular disease localized in well-definable parts of a muscle and its appendages—tendon, perimysium, fascia—corresponding anatomically to the origin; insertion is along the course or along the edge of a muscle. It may affect one (monomyalgia) or several muscles (polymyalgia) and is characterized by the following symptoms:

SUBJECTIVE SIGNS—(1) *Character of pain*; a dull aching, sometimes agonizing, pain occurring in attacks of a few minutes' duration or longer, with long intervals.

(2) *Heterotopicity of pain.* The painful areas as described by the patient are of a referred character and therefore misleading with regard to the localization of the diseased muscle.

(3) *Neuralgic symptoms*: paresthesic sensations — numbness, pins-and-needles — often are complained of, especially in hands and fingers or feet and toes. A very frequent complaint is stiffness.

(4) *Disturbed function*: diminished or temporary loss of power in a special muscle or muscle group, e.g., dropping things from hands or giving way of knees.

OBJECTIVE SIGNS—(1) Pressure on a myalgic spots elicits a severe and extremely agonizing pain which often is similar in character and extension to the spontaneous pain complained of.

(2) Pressure on such a spot produces an involuntary movement, e.g., jerking of head or

shoulder in a part of the body not pressed upon, or the patient "makes a face." This *sign* is *pathognomonic.*

(3) The myalgic spots, of which the patient is absolutely unaware, do not coincide with the painful skin area complained of and in fact often are far removed from it.

(4) In the area of referred pain, the skin often is hyperalgesic to pin-prick and light pressure, e.g., from a hot-water bottle.

(5) After appropriate treatment, applied to myalgic spots only, the local pain elicited by pressure, as well as the referred pain, disappear.

The general and local treatment was described in an earlier paper. A salt-poor vegetarian diet has proved a valuable adjuvant and infra-red ray treatment gives most excellent results, provided it is applied to the myalgic spots and not to the areas said by the patient to be painful. In combination with a strictly local massage, a lasting cure can be effected within a relatively short time. A more rapid cure, however, can be obtained by injection of procaine into the myalgic spots.

Conservative Treatment of Sciatic Pain in Low-Back Disability

John G. Kuhns, M. D. In J. Bone and J. Surg., April 1941.

This paper is a description of the conservative treatment and a report of the results in 1000 patients seen for sciatic pain and low-back disability during the past ten years. By conservative treatment is meant the use of rest in special positions, support, medications and physical therapy.

What can be regarded as adequate treatment of the usual cause of low-back disability—a muscular or ligamentous tear in the supporting structures of the lumbar spine and pelvis? It would be reasonable to believe that the treatment would be similar to that applied to muscular and ligamentous tears elsewhere in the body—that is, rest with the injured structures in a position of relaxation until healing is at least partially completed. It is possible to secure relaxation of most of the posterior ligamentous structures about the sacrum and lumbar spine by supine recumbency with the lumbar spine flat, and with slight flexion (20 to 30 degrees) of the hips. This has been demonstrated in the cadaver.

The best method of securing immobilization and ligamentous relaxation for the low back is to keep the patient constantly on a firm bed with the entire body horizontal except for slight flexion at the hip joint. This can be secured in the supine position by placing a pillow under the knees, or in the prone position, under the abdomen. Only in the mildest of low-back injuries is the patient permitted to be ambulatory.

In most instances while the patient is in bed, physical therapy, consisting of heat daily, should be given to the posterior surface of the spine and pelvis to improve the local circulation, to relax muscle spasm, to relieve pain and to hasten the absorption of inflammatory exudate. As soon as muscle spasm and pain begin to subside and the patient can move in the bed without much discomfort, exercises can be given to the patient to teach him muscular coordination so that he may improve the balance and carriage of the entire body to prevent further strain. The period that the patient must be kept recumbent varies greatly. Complete recumbency should be continued until pain and local tenderness have almost entirely subsided.

This does not mean the end of treatment. Usually a prolonged period of convalescence is required until the individual is again able to assume his usual activities. Physical therapy in the form of heat, exercises and recumbent rest in positions which do not sprain the low back for part of the day are continued for a longer period. If the patient is not pushed beyond his physical capacity and if the ligaments are prevented from being overstretched during healing, a gradual improvement in symptoms, in muscular tonus and in good carriage should be observed.

If this study is to be of value it should suggest which types of low-back pain probably will be relieved under conservative treatment. The types of low-back disability can be placed in four large categories:

1. *Acute Traumatic and Postural Strains of the Low Back.* All of these patients can be expected to recover under conservative treatment.

2. *Structural Changes in the Vertebrae or Their Contiguous Structures.* Where structural restoration cannot be expected, as in metastatic malignancies, conservative therapy may prolong function and is of great help in palliative treatment.

3. *Low-Back Pain from Pressure or Irritation within or about the Spinal Canal.* In this group conservative treatment may be of little avail.

4. *Pain Referred to the Back from other Parts of the Body, Usually the Abdominal and Pelvic Viscera.* There were no patients in this 1000 cases with low-back pain of this type. Here the lesion, which causes pain referred to the low back, should be treated.

Muscle Testing Around the Shoulder Girdle: A Study of the Function of Shoulder-Blade Fixators in Seventeen Cases of Shoulder Paralysis

Signe Brunnstrom, M. A. In J. Bone and J. Surg., April 1941.

The function of muscles must be studied primarily on the living human body. Careful observation and palpation of muscles on the normal individual yield a great deal of information; but for a thorough understanding of muscle action additional studies of paralysis cases are imperative.

From the standpoint of etiology, the seventeen cases chosen for the study are classified as follows: (1) injury or disease to the long thoracic nerve (one case), (2) injury to the spinal accessory nerve (four cases), (3) congenital muscular defects (seven cases), (4) muscle dystrophy (four cases) and (5) poliomyelitis (one case). These unusual types of shoulder palsy affect those muscles which connect the scapula and the clavicle with the main skeleton.

The purpose of this paper is twofold: (1) To discuss positions and movements which to the greatest possible extent bring out isolated action of the shoulder-blade fixators and which make palpation of each muscle possible, and (2) to show by actual examples the functional disturbances which accompany isolated paralysis of these muscles.

To avoid misunderstanding, the following definitions are given:

Upward rotation of the scapula will mean that the glenoid cavity is turned upward while the inferior angle moves away from the spinal column.

Downward rotation of the scapula will mean the reverse movement of the above. In complete downward rotation the inferior angle of the scapula is closer to the spinal column than the superior; bilaterally, the vertebral borders of the scapulae form the letter V.

Tipping forward of the scapula, that the coracoid process is lowered anteriorly while the inferior angle protrudes backward.

Tests for individual muscles are described.

Isolated paralysis of the trapezius, even in cases where the whole muscle is absent, does not interfere appreciably with the elevation of the arm. The disability is marked only when the subject abducts the arm with the trunk inclined forward.

Isolated paralysis of the serratus magnus causes far more disability than paralysis of the trapezius alone, as the subject is unable to elevate the arm above a horizontal position.

Paralysis of both the trapezius and the serratus magnus causes a very serious disability. The scapula completely lacks fixation, and abduction of the arm can be performed to approximately 60 degrees only.

Isolated paralysis of the rhomboids or the pectoralis minor was not present in any of the cases studied. The exact effect of the loss of one of these muscles, therefore, could not be determined. In cases with weak rhomboid muscles, resistive adduction of the arm proves to be rather difficult, as the teres major pulls the scapula toward the arm instead of pulling the arm toward the scapula.

Isolated paralysis of the levator scapulae was not found in any of the cases studied. When the upper trapezius is absent and the rhomboids weak, the subject has no difficulty in elevating the shoulder girdle against resistance. It seems, therefore, reasonable to assume that in normal subjects, too, the levator scapulae is the most important muscle for elevation of the shoulder girdle.

The etiology could not be determined with certainty in all cases, but five groups were recognized: injury to the long thoracic nerve, injury to the spinal accessory nerve, congenital defects, muscle dystrophy and poliomyelitis.

Treatment of Cerebral Palsy (Spastic Paralysis)

M. E. Pusitz, M. D. In J. Kansas Med. Soc. XLII, 2:62, February 1941.

This author concludes that there are no short cuts in the treatment of this condition. Since there is no possibility of regenerating dead nerve tissues, it is not a question of cure but rather of palliation, endeavoring to produce coordinated muscle action so as to induce function. The treatment does not consist of any one particular item but rather it must be considered as a routine of treatment (or a system of treatment as advocated by Robert Jones fifty years ago). In this, there is no heroic, no breath-taking procedure, but rather it is a slow methodical and gradual process, in which many items, and from different fields, are required. The physician must develop a working hypothesis of coordinated muscle action, so that a well rounded routine of muscle education can be instituted. This must form the nucleus about which all the work evolves. Surgery, or neurosurgery, as one, is not the treatment but as adjuncts they may be of inestimable value. Psychology or rather neuropsychiatry has a great deal to offer, but it has

reference more with the approach to the spastic athetoid case than to the actual treatment itself. Without it, however, the routine will suffer severely. We must avail ourselves of the wonderful opportunities we now have in the field of speech correction, physical therapy, muscle education, gymnastics, occupational therapy, etc. But we must not lose sight of the fact that in order for these fields to give maximum results (without any tendency to exaggeration of their value), they must be controlled by the physician who is well versed in the condition which is being treated. Educational and vocational guidance must be harnessed in this routine, so as to achieve the maximum results from therapy; although this objective probably will not be reached for some time.

Physical Therapy in Amputations

Council on Physical Therapy. In J.A.M.A., 116:14:1519, April 5, 1941.

Heat, massage and exercise—the basic components of physical therapy—play an important part in preparing the stump of an amputated limb for early and efficient function.

In stumps of recent amputations the local circulation usually is diminished and may be increased by heat applied locally at a moderate temperature of 96 F. for twenty minutes every two or three hours. Increased circulation helps to prevent fibrosis of the muscle, reduce edema and promote wound healing. Radiant heat is applied by an infra-red generator or by an electric lamp "baker."

In stumps healing without complication, massage should be started six or seven days after amputation. As the condition of the stump permits, four types of massage are given in the following sequence; superficial stroking massage, deep stroking massage, kneading massage and friction massage.

Passive Exercise.—Four or five days after amputation the stump is removed from its elevated position twice daily, and the stump and its adjacent joints are moved passively without putting undue traction on the wound or causing too much pain. These passive movements take the stump and joints through what would be their normal range of motion; the stump is also moved as far as possible in the direction opposite to that in which a contracture is likely to develop.

Stretching Exercise.—Such exercises are used when massage and passive exercise have not served to prevent muscle contracture. After amputation through the upper third of the thigh, contractures often limit hip extension and abduction. Contractures of this type are effectively stretched by using a special table devised during the First World War and used in England and the United States.

Pressure Exercise.—Unless there is some contraindication, the patient is directed, while the dressings are still in place a week or ten days after amputation, to pound gently the end of the stump with the palm of his hand. The force and number of blows increase as rapidly as the condition of the stump permits. Using this exercise with accompanying massage, the patient loses his fear of hurting the stump.

Active Exercise.—For efficient use of an artificial limb the strength of the muscles in the remaining part of the amputated extremity must be equal to the muscle power of the opposite normal member. Active exercise is the means by which muscle strength of the stump is increased, and application of such exercise diminishes the two great difficulties accompanying the use of an artificial limb—limitation of joint motion and weakened muscles in the stump.

Arm Amputation.—It is essential to prescribe definite active exercise for all the joints proximal to an arm amputation as soon as possible. Adduction exercises for the shoulder prevent atrophy of the deltoid and supraspinatus, and external rotation prevents atrophy of the infraspinatus and teres minor. Numerous exercises can be devised for patients having arm amputations by using a simple apparatus consisting of a weight, cuff, rope and two pulleys.

Leg Amputations and Reeducation.—Learning the mechanics of standing and walking with an artificial limb involves reeducation as to the coordination of movement in the muscles of the stump and as to the tactile, muscular and joint sensation in the remaining part of the limb. Patients having amputations below the knee experience little difficulty in learning the mechanics of walking and standing with an artificial limb. The reeducation necessary to teach a patient with a thigh amputation the mechanics of walking depends on the length of the stump, the motion of the hip joint and the strength and function of the muscle.

Occupational therapy is more interesting to the patient than formal gymnasium exercise and through games and work provides exercise for increasing the muscle strength in the stump. The occupational therapy technician must be given careful instruction as to which muscles of the stump require developing.

Training in Human Muscles Working With and Without Blood Supply

G. L. Maison and A. G. Broeker. In the Amer. J. Physiol., 132:2:390, March 1, 1941.

If a muscle is used daily to perform voluntary work its capacity for work will undergo marked enhancement by a process known as muscle training. Little is known of the mechanism by which the power of the muscle increases. It is possible that local changes in the muscle cells themselves may be responsible. Biochemical studies devoted to measuring changes in constituents of muscle as a result of training have not been very illuminating. It is possible that changes in the innervation of the muscle are responsible. This might involve the building of resistance to fatigue in the cells of the motor cortex or the anterior horn or a more economical usage of motor discharge. It is possible that changes in the blood supply may be responsible in increasing the oxygen available and facilitating the removal of metabolites. It seemed reasonable that removal of the influence of the circulation might yield significant information about this problem. Accordingly the training characteristics of muscle working in an ischemic condition (i.e., without blood supply) have been investigated.

4. It is concluded that the anaerobic energy release mechanism in muscle undergoes little change as a result of training. Training would seem to be largely a phenomenon of improvement in nervous direction and vascular supply.

Use of Acetyl-Beta-Methylcholine Chloride Iontophoresis in Nonarterial Peripheral Vascular Disease

Hugh Montgomery, M. D. With the Technical Assistance of Sara C. Turner and Elizabeth C. Sammis. In American J. Med. Sci., 201:2:277, February 1941.

"The present paper deals with the results of treating 42 patients by acetyl-beta-methylcholine chloride iontophoresis in the Peripheral Vascular Clinic from October 1937, to August 1940.

"Ten of the 42 patients had varicose ulcer, 6 post-thrombophlebitic ulcer, 11 chronic or subacute thrombophlebitis without ulcer, 6 ulcers of other origin, 6 scleroderma and 3 had miscellaneous disorders. Patients with occlusive arterial diseases were not chosen for treatment because the results of others have not been sufficiently favorable.

"*Summary.* Acetyl-beta-methylcholine chloride iontophoresis greatly increases cutaneous blood flow and is a useful adjunct to the therapy of some nonarterial peripheral vascular disorders. The augmented blood flow may be the cause of the improvement. It is recognized that the disorders for which the procedure has been recommended are chronic and usually relapsing under most forms of accepted therapy. There is some beneficial result in some cases of scleroderma, but therapy must be continued over a long period of time. Varicose and post-thrombophlebitic ulcers tend to become smaller, cleaner and less uncomfortable, but they usually fail to heal and the benefits are usually transient. The procedure is recommended for the treatment of these ulcers only after more direct measures have failed or before surgical treatment is instituted. It is not a substitute for surgical measures designed to correct incompetence of venous valves, but it does help improve ulcers sufficiently to make surgery safer. The best results are obtained in relieving post-thrombophlebitic discomfort. The dangers of acetyl-beta-methylcholine chloride iontophoresis are remote, with the exception of burns which occur when electrode metal touches skin, or when the importance of the relation of the strength of the current to the size of the electrodes is not appreciated."

The Arterial Circulation of the Lower Extremities in Chronic Arthritis

Otto Steinbrocker, M. D., and Saul S. Samuels, M. D. In J. Labor. and Clinical Med., 26:6:974, March 1941.

1. In a clinical investigation of rheumatoid arthritis, 65.9 per cent of the patients showed abnormalities, usually vasomotor disturbances, of the arterial circulation of the lower extremities; in osteoarthritis 35.2 per cent of the cases presented similar findings. Three rheumatoid patients, or 6.3 per cent, had simultaneous arteriosclerosis obliterans.

2. Study of those patients with arthritis presenting arterial abnormalities showed no direct, consistent relationship between the location of the vascular signs and the site of the arthritic process. The evidence suggests that the vasomotor disturbances in chronic rheumatoid arthritis and related conditions may be attributed to some systemic reaction probably acting through the sympathetic nervous system, although in some cases a local irritative reflex vasospastic mechanism in the painful arthritic extremity cannot be ruled out.

3. In a control group of 86 patients with advanced organic arterial disease, 28, or 32 per cent, offered a history, physical signs or roentgen changes of rheumatic or arthritic involvement at some time. These findings approximate the incidence of such ailments in similar age groups of individuals without arterial disturbances and contribute clinical evidence that pronounced arterial disease alone does not usually produce arthritic signs and symptoms.

The Problem of Rheumatism and Arthritis —Review of American and English Literature for 1939 (Seventh Rheumatism Review—Part I

Philip S. Hench, M.D., F.A.C.P.; Walter Bauer, M.D., F.A.C.P.; M. Henry Dawson, M.D.; Francis Hall, M.D., F.A.C.P.; W. Paul Holbrook, M.D., F.A.C.P.; J. Albert Key, M.D., F.A.C.S.; and Currier McEwen, M.D., F.A.C.P.
In Annals of Int. Med., 14:8:1383, February 1941.

Several physicians considered the combined use of fever therapy with chemotherapy better than either alone and recommended this combination in cases of sulfanilamide-resistant gonorrheal arthritis. The combination was said to be successful in from 90 to almost 100 per cent of cases resistant to either alone.

Fever therapy does not alter the concentration of sulfanilamide in blood except as it slows intestinal absorption of the drug. Sulfanilamide with fever therapy does not increase the hazards of the latter.

Methods. The development of artificial fever and methods for its production were discussed. Results and hazards were considered about equal, whether fever was produced by the induction method, by hot moist air or by hot sprays of water. Many workers favored 10 to 12 hour fever sessions, especially in gonococcal infections, either with or without sulfanilamide and with additional local pelvic heating.

Preparation of Patient and Management during Fever. Those who use fever therapy are referred to several reports on the preparation of patients for fever treatments and on their management during fever.

Complications, Untoward Results. Careful selection and management of patients during fever sessions has made the procedure relatively safe. Minor reactions (headache, nausea, vomiting, tetany, muscle cramps, herpes labialis) were common. Serious reactions like neuronitis and other neurologic changes, some of which were transient, some permanent, were rare. Three deaths from fever therapy occurred. The parenchymatous, necrotic, hemorrhagic and congestive changes that can affect tissues, especially the liver, from overdoses of fever were studied.

Treatment of Brucellosis

Fever Therapy. Of 15 patients given fever therapy (three sessions of five hours each, 105 to 106 F. rectal) 80 per cent were "greatly improved" although this amount of fever will not kill Brucella organisms in vitro.

Treatment of Rheumatic Fever

Rest. This is the all important remedy in active rheumatic fever. Complete rest in bed is essential in the presence of persisting infection. When the patient is allowed out of bed, the resumption of normal physical activity must proceed slowly; first gradually increased time in a chair, then cautiously increased walking on the level, finally climbing of stairs and other activity. Convalescent care is important. Needed are more institutions for the sanatorium care of rheumatic convalescents. Although rest is vital in cases of active rheumatic fever, it is not indicated for those of inactive rheumatic heart disease unless definite cardiac decompensation is present. The important factor in inactive rheumatic disease is not rest but the avoidance of a recurrence of the active infection. There is danger of inducing cardiac neurosis by enforcing unnecessary rest on patients with inactive rheumatic heart disease simply because of the presence of murmurs.

Fever Therapy. Of 20 patients with Sydenham's chorea given artificial fever by Elkins and Krusen, eight obtained complete clinical remissions; seven others, slight to marked improvement. Having treated 70 choreic patients, E. L. Bauer concluded that artificial fever therapy not only stops the choreic attack but also lessens the number of recurrences of rheumatic fever and the extent of cardiac damage. Fever therapy was considered by some of value not only for chorea but for the carditis also. But other physicians disagreed.

(The use of fever therapy for rheumatic manifestations other than chorea should be considered experimental.—Ed.)

Miscellaneous. The effect of heliotherapy was not marked, but was pleasing to children so treated. "Improvement" was obtained by 17 of Poulton's 26 rheumatic patients treated in an oxygen tent for from one week to 82 days.

Treatment of Atrophic Arthritis

According to their attitude on the treatment of this disease physicians can be classified as (1)

the pessimists or nihilists, (2) the optimists and wishful thinkers, and (3) the realists.

Some recent generalizations on treatment included the following: "Probably no part of medicine is more impotent than that which deals with arthritis," wrote Creer. "Our orthopedic clinics are littered (I can think of no better word) with such cases." The arthritic patient is, "generally speaking, badly treated in the long run, either because the average physician considers the condition unworthy of exhaustive treatment in the beginning or considers it hopeless when well developed" (Wheeldon). "The enthusiastic neophyte tries first, the panaceas described in the best medical journals, next those noted in ordinary medical journals and then quietly sanctions the use of the miraculous cures found in any daily newspaper" (Weinstein). Although no specific remedy is yet available the intelligent application of the best of current methods is productive of worth-while results and patients should not rely on "nature" to stop the disease. "Some patients believe that arthritic pains, like the wicked will flee when no man pursueth but we can assure you that they make better time when the doctor takes after them" (Wyatt and Thompson).

"Between a strong therapeutic nihilism on the one hand and wishful thinking on the other, there is a middle ground in the care of arthritics, within which many experienced students and clinicians find cause for great optimism," according to Pemberton. Studies on the effects of jaundice and pregnancy show that the pathologic physiology of atrophic arthritis is more rapidly reversible than was previously supposed. The physician treating arthritis has "already available many, sometimes all, of the varied mechanisms necessary to a true reversal of the disease." But he takes his therapeutic cue from those studying the disease and "unless a reasonably wide-angled, and above all, coordinated program be presented to him, he cannot be blamed if he turns from academic negativism to the samples sent him by the drug house."

Physical Therapy. Current articles on the use of various types of physical therapy in arthritis contained little that was new. The importance of physical therapy was everywhere recognized but there were "emphatic" differences of opinion as to the most suitable form for different conditions. Physicians must not buy one machine and use it in all cases; one must choose that type of physical therapy which will give the most relief to the individual patient. Every therapist should have a "museum room where discarded apparatus in which we once had faith may be placed and catalogued. This would forever furnish a lesson in humility" (Heyman).

Some general articles on the latest developments in physical therapy appeared. The case for infra-red irradiation was presented, but it has recently been shown that even the most penetrating infra-red rays are largely absorbed by the skin. The advantages and contraindications of short wave as contrasted to long wave "conventional" diathermy were debated. There is no great difference between the two forms, but "short wave diathermy" apparently produces deeper, more uniform heating and is more readily applied. Fangotherapy is helpful, but inadequate as a sole means of treatment.

Further data on the optimal method of using contrast baths were reported by Collins, Ernst and Woodmansey. These were summarized in last year's Review. In England best reactions were not obtained with the usual one minute hot, one minute cold, one minute hot technic, but with a cycle of eight minutes hot, three minutes cold, or six minutes hot, two minutes cold. In America (where patients tolerate cold less well than in England) the best technic was five or six minutes in hot water (about 113 F. or 45 C.) and not over two minutes in cold water (about 45 F. or 7.2 C) alternating back and forth for 30 to 40 minutes, beginning and ending in the hot water.

The urgent necessity of supplementing professional physical therapy with home treatments was again stressed. "A thirty or forty minute baking or a short wave treatment three times a week will cause very little or no increase of the circulation of fingers, but if this is supplemented by home treatment with hot packs, heating lamps or other measures, much more adequate treatment is rendered. Coulter stated that physical therapy once daily is insufficient; it should be applied at short intervals during the day. Simple methods for home treatment were outlined.

The effects and technic of massage and also the advantages of various types of hydrotherapy were reviewed. Hydrotherapy is not indicated in cases of febrile atrophic arthritis. To ascertain the proper type of hydrotherapy for a given patient the capacity of his skin to perspire must be studied. When in doubt the milder forms of hydrotherapy should be selected until the evidences of free lymphatic circulation and prompt skin reaction warrant the use of stronger forms. "Bath crises" ("getting worse before getting better") can thus be avoided. The special advantages of spa therapy were presented.

Book Reviews

A STUDY OF THE RESULTS OF TREATMENT IN 1103 CASES OF LOBAR PNEUMONIA. By Hugo Mella, M. D., Postgraduate Instruction and Medical Research Division, Medical and Hospital Service, Veterans' Administration, Washington, D. C. Paper. Pp. 37. Bedford, Mass.: Occupational Therapy Printing Department, Veterans' Administration Facility, 1940.

This is a report of 1103 patients treated for lobar pneumonia in the Veterans' Administration Facilities. Of these 342 were treated with specific serum only, 29 with specific serum and sulfanilamide, 14 with specific serum and sulfapyridine, 6 with specific serum and prontylin, and one with specific serum and antibody solution. Seventy-one cases treated with sulfapyridine within the same period and reported in January 1940 are included in this survey.

APPLIED NEUROANATOMY. PART I: THE SPINAL CORD. By Rafael Hernandez, B. S., M. D., Professor of Neurology, Meharry Medical College, Nashville. Paper. Price, $3.50. *Pp.* 123, *with* 95 *illustrations. Ann Arbor, Michigan: Edwards Brothers, Inc.,* 1941.

The subject of neuroanatomy is one which always has been an enigma for most medical students. The task of simplifying so complex a subject is indeed not an easy one. This book is another attempt to stress the more important features of anatomy of the spinal cord which will best serve the student later in his medical career. The text is amply illustrated by fine drawings which always are helpful to the student. Good bibliographies are included at the end of each chapter and the text is arranged in an excellent manner.

THROUGH CHILDREN'S EYES. By Blanche C. Weill, Ed. D. Cloth. Price, $2.75. *Pp.* 365. *New York: Island Workshop Press, Co-op., Inc.,* 1940.

This is a story of children and their problems as told by them and as interpreted by the author who is a consultant psychologist in child and family problems in New York City. In this book such problems are approached from the child's point of view rather than in the usual manner—or from the adult's point of view. Various types of reactions are included such as the child's thinking he was not loved, that he could not get what he wanted, taking refuge in illness, behavior problems and questions of adoption. All of these are everyday problems which occur when we are treating or caring for children—normal or handicapped. The author's interpretations are very practical and illuminating to the average adult. Children's behavior depends upon the behavior of adults with whom they come in contact, and the purpose of this book can best be illustrated by one child's simple suggestion. Not until she received a proposal of "I'll be good if you'll be good," did a certain mother realize that she had been impatient with her child.

Parents, teachers, social workers or anyone dealing with children could well profit by reading this book and considering its plea for the understanding of children.

PHYSICALLY HANDICAPPED CHILDREN IN NEW YORK CITY. General Report of The Committee for the Study of the Care and Education of Physically Handicapped Children in the Public Schools of the City of New York. Prepared by Harold W. McCormick, Ed. D. Cardboard. Pp. 91. *Compliments of the Committee. New York: The Board of Education of the City of New York,* 1941.

This report gives the history and development of the special educational programs for the physically handicapped in New York City. It discusses the general considerations in the education of the handicapped; the organization, administration, extent and cost of the program; the general aspects of the program, and the special programs for the physically handicapped children. This volume will be of interest to those concerned with educational programs for physically handicapped children.

PEDIATRIC BIBLIOGRAPHY. By A. Graeme Mitchell, Department of Pediatrics of the College of Medicine, University of Cincinnati, and the Children's Hospital Research Foundation, Cincinnati, Ohio. Paper. Price, 75c. *Pp.* 119. *Washington, D. C.: Society for Research in Child Development, National Research Council,* 1941.

This is a reference list of pediatric subjects gathered over the last thirty years. Whenever possible Mitchell has utilized reviews or articles with extensive bibliographies so the list would not become too cumbersome. The list has been made as practical as possible by including references which are accessible. This bibliography is of great value to the student and practitioner of pediatrics.

THE BIOLOGIC FUNDAMENTALS OF RADIATION THERAPY. A TEXTBOOK. By Friedrich Ellinger, M. D., Research Fellow, Radiotherapy Department, Montefiore Hospital, New York City; Formerly Privatdozent in Radiology at the University of Berlin. With a preface by Maurice Lenz, M. D., Associate Clinical Professor of Radiology, Columbia University; Director of City Cancer Hospital; Chief of Radiotherapy Departments, Presbyterian Hospital and Montefiore Hospital, New York City. English translation by Reuben Gross, M. D., Formerly Resident Physician Radiotherapy Department, Montefiore Hospital, New York City; First Lt. M.C., U. S. A. Cloth. Price, $5.00. Pp. 360, with 79 illustrations. New York: Nordemann Publishing Co., Inc., 1941.

The author states that the impression frequently is given that the therapeutic application of radiant energy differs in principle from that of drugs. He continues: "With this presentation of the biological fundamentals of radiation therapy, I hope to demonstrate the equality of basic principles in the use of radiant energy and chemicals for therapeutic purposes, and thus simplify comprehension of the problems of radiation therapy."

This volume gives a comprehensive survey of the enormous mass of literature on this subject. The bibliography contains 1100 references. The book is divided into five parts considering: (1) the action of roentgen rays and radiation of radium; (2) the corpuscular rays; (3) ultraviolet light; (4) further effects of light, and (5) general radiation biology and therapy.

In the third and fourth parts the direct and indirect effects of ultraviolet radiation, visible light and infra-red rays are thoroughly discussed. This book should be helpful to everyone interested in ultraviolet radiation therapy.

THE CHEMICAL ACTION OF ULTRAVIOLET RAYS. By Carleton Ellis and Alfred A. Wells. Revised and enlarged edition by Francis F. Heyroth, M. D., Ph. D., University of Cincinnati. Cloth. Price, $12.00. Pp. 961. New York: Reinhold Publishing Corporation, 1941.

This volume has been expanded to include recent work, and a large portion has been rewritten to be in accord with the altered interpretation of many reactions which are shown by advanced study in this field. Certain explanatory chapters regarding the modern viewpoint have been added for readers who may not have had the advantage of recent advanced courses in physical chemistry. These chapters describe in nonmathematical fashion an understanding of the manner in which certain wave lengths may supply the activation energies of chemical reactions.

After an introduction describing the nature of ultraviolet radiation, part I discusses in considerable detail the sources of ultraviolet radiation. In dealing with photochemical processes in part II a few representative reactions are at first discussed at length to illustrate the manner in which the mechanism of a reaction may be studied. Then in the subsequent chapters of this part, the literature of a wide variety of photochemical processes is summarized.

In part III the applications of photochemistry to industrial products are treated in a somewhat empirical manner since but few investigators in this field have made full use of the current theoretical advances. Applications of ultraviolet rays in biology are discussed in part IV. Here the emphasis is placed upon the photochemical changes occurring in the compounds present in the living cells and their resultant effects upon viability and function. The engineering and public health aspect of this work have not been neglected. The scope and limitations of ultraviolet radiation therapy are considered but not the details of treatment.

This book contains much valuable information for all who are interested in the field of the chemical action of ultraviolet radiation.

STUDIES FROM THE CENTER FOR RESEARCH IN CHILD HEALTH AND DEVELOPMENT, SCHOOL OF PUBLIC HEALTH, HARVARD UNIVERSITY. III: THE GROWTH OF BONE, MUSCLE AND OVERLYING TISSUES AS REVEALED BY STUDIES OF ROENTGENOGRAMS OF THE LEG AREA. By Harold C. Stuart, M. D., Penelope Hill and Constance Shaw. Monographs of the Society for Research in Child Development. Volume V. No. 3. (Serial No. 26). Paper. Price, $1.25. Pp. 220, with illustrations. Washington, D. C.: Society for Research in Child Development, National Research Council, 1940.

This is a biometrical study of the manner of growth of the primary tissues of the leg as revealed by roentgenological measurements. The monograph consists of a collection of data of normal individuals and attempts to correlate structural growth with other factors such as heredity, environment, diet and so forth.

INTRODUCTION TO PSYCHOBIOLOGY AND PSYCHIATRY: A TEXTBOOK FOR NURSES. By Esther Loring Richards, M. D., Sc. D., Associate Professor of Psychiatry, Johns Hopkins University, Baltimore. Cloth. Price, $2.50. Pp. 357. St. Louis: The C. V. Mosby Company, 1941.

This is an excellent book on the fundamental aspects of psychiatry. The author has had long association with the Adolf Meyer school of psychobiology and rich experience in the practice of psychiatry. Although the book has been written primarily for nurses and students, it can be highly recommended to the general practitioner as well. Careful wording and simplicity of arrangement characterize this text.

The early chapters deal with the historical background of psychobiology and its fundamental concepts through which one becomes acquainted with the integration of the total personality. By the method of personality study, a self analysis, normal psychologic mechanisms are made familiar. The second part of the book deals with psychopathology in which deviations in personality are explained. The special terminology used in psychobiology is clarified in an interesting and instructive manner.

TREATMENT IN GENERAL MEDICINE. 1941 PROGRESS VOLUME. Edited by Hobart A. Reimann, M. D., Magee Professor of Practice of Medicine and Clinical Medicine, Jefferson Medical College, Philadelphia. Cloth. Pp. 392. Philadelphia: F. A. Davis Company, 1941.

This is a progress volume supplementary to the three volumes of "Treatment in General Medicine" published in 1939. Although this volume presents new methods of treatment, the policy followed in the original volumes of giving also a brief discussion of etiology, pathogenesis, pathology, physiology and symptoms has been adhered to generally.

The following subjects are discussed: treatment of infectious diseases, of syphilis, of diseases caused by protozoa, of diseases caused by metazoa, of diseases of unknown etiology (rheumatic fever and atrophic arthritis), of contagious diseases of childhood, of diseases of the heart, of abnormalities of blood pressure and diseases of the blood vessels and lymph vessels of the extremities, diseases of the gastro-intestinal tract, infections of the kidney, diseases of the genito-urinary tract, diseases of the respiratory tract, disorders of the endocrine glands, diseases of the blood and blood forming organs, transfusion of blood and blood substitutes, diseases of nutrition and metabolism, diseases due to hypersensitivity, diseases of the skin, treatment in pregnancy and labor, diseases of the anus and rectum, diseases caused by physical and toxic agents, minor surgery, new developments in radiotherapy and physical therapy.

This can be recommended as a valuable addition to Reimann's "Treatment in General Medicine." It is of interest to those physical therapists who have the original work as the last section edited by Dr. John S. Coulter gives the new developments in physical therapy.

A HISTORY OF MEDICINE. By Arturo Castiglioni, M. D., Formerly Professor at the University of Padua; Research Associate in the History of Medicine at Yale University. Translated from the Italian and edited by E. B. Krumbhaar, M. D., Ph. D., Honorary President of the American Association of the History of Medicine. Cloth. Price, $8.50. Pp. 1053, with 443 illustrations. New York: Alfred A. Knopf, 1941.

This history of the science and art of medicine from prehistoric times down to the present shows the close relation between the progress of medicine—connected more than any other science with the essential needs of life—and the progress of civilization.

This volume is of particular interest to physical therapy technicians because of its numerous references to the use of physical agents. The first people in the history of civilization in Mesopotamia are the Sumerians, whose culture belongs in the fourth or fifth millennium B. C. Their writings on tablets of clay show that the physician was designated by a name meaning: "He who knows the waters." From this early beginning numerous interesting references are made to the use of physical agents throughout the ages.

The author, being an Italian and formerly professor at the University of Padua which is one of the oldest universities in the world, calls attention to some Italian physicians who are not usually mentioned in our list of pioneers in physical medicine. For instance, in the use of hydrotherapy in Italy in addition to Savonarola who is well known in the history of this subject he mentioned Christopher Barzizio (1450); Settala, a Milanese physician; and Domenico Cirillo (1739-99) of Naples.

This book is well written and the many excellent illustrations add to the interest of the book. There is a most complete bibliography. This is a book that everyone interested in medical history can read with pleasure and profit.

PRINCIPLES OF ABNORMAL PSYCHOLOGY: THE DYNAMICS OF PSYCHIC ILLNESS. By A. H. Maslow, Ph. D., Brooklyn College, and Bela Mittelmann, M. D., New York Post-Graduate Dispensary Service of Neurology and Psychiatry. Cloth. Price, $3.50. Pp. 638. New York: Harper and Brothers, 1941.

For the understanding and treatment of nervous and mental disorders a thorough grounding in the fundamentals of normal as well as abnormal psychology is essential. This book is the result of the collaboration of a psychologist and a physician in an attempt to supply such information to the student and practitioner.

The early chapters deal with the normal personality, unconscious psychologic processes and deviations from the normal with a view toward leading up to the understanding of the psychopathology which underlies nervous disorders. The importance of early childhood experiences is given proper recognition. The later chapters deal with the more common neuroses and psychoses and also describe the technics of psychotherapy. An excellent bibliography and a valuable glossary are included, all of which add to the worth of this excellent treatise.

A DIABETIC MANUAL FOR THE MUTUAL USE OF DOCTOR AND PATIENT. By Elliott P. Joslin, M. D., Sc. D., Medical Director George F. Baker Clinic at the New England Deaconess Hospital, Boston. Seventh edition. Cloth. Price, $2.00. Pp. 238, with 53 illustrations. Philadelphia: Lea & Febiger, 1941.

This edition of this popular manual for diabetics contains much new material, including two chapters of questions and answers which clarify and emphasize the essential instructions. It includes discussions of the new discoveries in the prevention and care of diabetes and reflects the hopefulness which they have engendered. It shows the patients how to keep well by utilizing the satisfying diets now made possible by protamine insulin.

Many physical therapists are called upon to treat various complications of diabetes. During treatment a diabetic is likely to ask many questions about his condition and its treatment. This manual should be in every physical therapy department to use as a guide in giving information to the patient. The physician will find it valuable to lend to the patient or to show to him with the advise that he purchase a copy for his home library.

SCHIZOPHRENIA IN CHILDHOOD. By Charles Bradley, M. D., Medical Director, Emma Pendleton Bradley Home, East Providence, Rhode Island. Cloth. Price, $2.50. Pp. 152. New York: The Macmillan Company, 1941.

Although schizophrenia, or dementia praecox, has been looked upon as a mental disorder which is liable to occur at the time of puberity or later, its occurrence in childhood is commented upon every so often in the current literature. The author of this text has collected all the available literature on this subject and has produced a monograph which will be found of much value to the psychiatrist, the pediatrician and others who deal with children. It is well to recognize unusual behavior as early as possible, particularly if prophylactic therapy is to be utilized. Such primary symptoms as extreme seclusiveness, excessive daydreaming and bizarre behavior should be recognized as schizoid characteristics. Although the prognosis in schizophrenia is a gloomy one, nevertheless the victim of this malady deserves the best that the physician can offer. Early recognition and intelligent supervision should minimize undesirable complications which otherwise usually occur in cases of schizophrenia.

THE THERAPY OF THE NEUROSES AND PSYCHOSES: A SOCIO-PSYCHO-BIOLOGIC ANALYSIS AND RESYNTHESIS. By Samuel Henry Kraines, M. D., Associate in Psychiatry, University of Illinois, College of Medicine; Assistant State Alienist, State of Illinois; Diplomate of American Board of Psychiatry and Neurology. Cloth. Price, $5.50. Pp. 512. Philadelphia: Lea & Febiger, 1941.

This is an excellent book for students of nervous and mental disorders. The author, a product of the Adolf Meyer school of psychobiology, has attempted to describe the various symptoms observed in the neuroses and psychoses and illustrates by case histories to clarify definitions which might otherwise be difficult for the student to comprehend. Therapy is stressed throughout the text and consequently the general practitioner, and indeed also those who deal specifically with nevous and mental diseases, will welcome such a presentation.

Although there is much in the text which may not meet with the approval of other specialists in this field, the book is a sincere attempt to clarify many of the complexities met with in the difficult subject of psychiatry.

MILITARY MEDICAL MANUAL. Foreword by Major General James C. Magee, The Surgeon General, U. S. Army. Fourth edition. Cloth. Price, $4.50. *Pp.* 877, *with illustrations. Harrisburg, Pa.: The Military Service Publishing Company,* 1940.

This volume presents information of practical value to officers of the Medical Department of the Army of the United States. The sources of the subject matter are official publications of the War Department and the instructional material published by the general and special service school.

Part one discusses the organization and tactical employment of the Army of the United States. The second part presents the history of the evolution of the medical department, its organization and activities, field sanitation, essentials of preventive medicine and military hygiene, first aid, aviation medicine and the medical aspects of chemical warfare. Part three contains complete and detailed information about the tactical employment of medical units in the field and includes the subject of administration, supply and mess management.

This volume should be read by everyone serving with the Medical Department of the United States Army.

MASSAGE IN NURSING CARE. By Kathryn L. Jensen-Nelson, M.A., R.N., formerly General Director of Physical Therapy Instruction to Students in Washington Sanitarium and Hospital School of Nursing, Takoma Park, Maryland, and in Thirty Allied American and Foreign Schools of Nursing. Second Edition of Fundamentals of Massage. Cloth. Price, $2.00. *Pp.* 152, *with* 26 *illustrations. New York: The Macmillan Company,* 1941.

This volume presents the essential facts in the science and art of massage which the author believes are fundamental in the education of any nurse. The subject is considered under the following headings: history; nomenclature and rules to be followed in massage; general physiological effects of massage; massage procedures; general application of massage; massage in conditions involving the skeleto-muscular and circulatory systems; and massage and exercise in conditions affecting the nervous and gastro-intestinal system.

There is an outline at the beginning of each chapter, questions and exercises at the close, with suggestions for the laboratory periods. It can be recommended as a good textbook on massage for nurses' training schools.

WHO ARE THESE? WRITINGS FROM PSYCHIC SOURCES. Presented by Owen Redington Washburn. Cloth. Price, $1.50. *Pp.* 155. *Philadelphia: David McKay Company,* 1941.

The subject of metaphysics has numerous devotees. For them the present text will prove extremely fascinating inasmuch as messages from famous personages, long since deceased, make themselves once again a part of the present life. Such a book is not the type of reading matter for those more scientifically minded, unless one's curiosity permits him such an indulgence.

MAN. THE MECHANICAL MISFIT. By G. H. Estabrooks, Professor of Psychology, Colgate University. Cloth. Price, $2.50. *Pp.* 251. *New York: The Macmillan Company,* 1941.

This is an interesting argument to prove that when man, who inherits a body prepared through fifty million years of mammalian evolution, is put into modern civilization he becomes recognizable as a mechanical misfit. The author points out that as a result of modern civilization the individual as well as the race degenerates. Of the many forms of life, human beings and domestic animals alone breed back into the species traits unfit for survival.

Science keeps our weaklings alive to propagate their weakness, but only the fit are given the honor of facing the machine gun and tank. The author believes that we know the answer to the problem. For example, if we were to sterilize all the mentally retarded for just one generation, feeble-mindedness would practically cease to exist. Science has the key to this problem but the majority of people in this democracy will not tolerate science working in the field of human relations.

Science has the answer to another racial problem—war. The answer is simple. Stop it! Estabrooks believes that there may have been a time when war was of real advantage to the race as the unfit were killed off and only those of superior ability were able to survive. If so, that time has passed. It is doubtful if one per cent of fathers and mothers are in favor of sending their sons to war, but in these days one per cent evidently is a majority. The wholesale butchering of our best racial stock settled nothing in the last war. It is one more step towards racial deterioration. Nature's great law, survival of the fittest, here is not only ignored; it is reversed.

This book can be recommended as a thought provoking argument.

PHYSICAL THERAPY AS A CAREER. Editorial Director, John A. Lapp, LL. D., formerly Head of Department of Social Sciences, Marquette University. Paper. Price, $1.00. Pp. 20. Chicago, Illinois: The Institute for Research, 537 S. Dearborn Street, 1941.

This is a good analysis of what physical therapy has to offer as a career. It discusses briefly the history, physical therapy of today, where the physical therapy technician works, opportunities, physical therapy equipment, the physical therapy technician's duties, a day with a physical therapy technician, attractive features, unattractive features, personal qualifications, education, salaries, how physical therapy technicians get started, and associations. It is a useful pamphlet to recommend to prospective students of physical therapy schools.

ARTHRITIS AND ALLIED CONDITIONS. By Bernard I. Comroe, A.B., M.D., F.A.C.P., Instructor in Medicine, University of Pennsylvania; Senior Ward Physician, Hospital of the University of Pennsylvania. Second edition, thoroughly revised. Cloth. Price, $9.00. Pp. 878, with 242 illustrations. Philadelphia: Lea & Febiger, 1941.

This edition has important changes in practically every chapter and has been enlarged by the addition of 126 pages and 42 illustrations. It discusses in detail what every practitioner wants to know about arthritis. Numerous summaries are presented in box form to enable the general practitioner to obtain quickly most of the information which he requires, without spending the time necessary to digest carefully the more detailed text.

This volume has a unique feature of interest to every physical therapy technician. It gives complete descriptions of the use of physical methods in the treatment of all forms of arthritis. These descriptions give complete technic for the application in the hospital and for home use. There are 50 pages on physical therapy in rheumatoid arthritis discussing fully the use of heat, hydrotherapy, ultraviolet radiation, diathermy, iontophoresis, massage and exercises in arthritis. Splinting, the prevention of deformities and the orthopedic management of arthritis are discussed in other chapters.

There are chapters on fever therapy and on spas. The latter discusses the value of spas, together with a listing of the American spas, and the approximate expense involved.

In fibrositis the use and technic of dry cupping, histamine by iontophoresis, heat and massage are fully given. This volume also contains excellent and complete descriptions of physical methods in the treatment of the painful shoulder, painful feet, backache and sciatica. This is a work that should be in the library of everyone treating arthritis and allied conditions.

PHOTODYNAMIC ACTION AND DISEASES CAUSED BY LIGHT. By Harold Francis Blum, Ph. D. American Chemical Society Monograph Series, No. 85. Cloth. Price, $6.00. Pp. 309, with 50 illustrations. New York: Reinhold Publishing Corporation, 1941.

This is one of the American Chemical Society's Monograph Series. The subject is presented in four parts: an introduction which considers the nature and general biological effects of radiation; photodynamic action; diseases produced by light in domestic animals, and diseases produced by light in man.

Physical therapists and dermatologists will be interested in the most complete presentation and classification of the human diseases which are caused by light. The author gives the following general classification: (1) skin lesions produced only by radiation which induces the sunburn of normal skin, and (2) skin lesions due to abnormal photosensitizing substances in the skin. This subject is discussed under the folowing heads: abnormal sensitivity to light in man; the response of normal skin to light; the sunburn spectrum; abnormal response to blue and violet light (urticaria solare); the photosensitizing action of porphyrins; abnormal sensitivity to the sunburn spectrum (polymorphic light eruption); effects of long exposure to sunlight (skin cancer and the sunburn spectrum, Xeroderma pigmentosum); photosensitization by substances coming into contact with the skin; photosensitization by substances applied internally and other diseases attributed to light.

In this part, after summarizing the experimental results on the production of malignant tumors by ultraviolet radiation, the author states: "While it is unwise to apply directly to man the finding that skin malignancy can be produced in laboratory animals by exposure to light, it is still less wise to minimize the possibility that a malignancy of human skin may result from excessive insolation. This is particularly true in a public convinced of the hygienic and esthetic value of sunbathing." This is a valuable reference book for those interested in ultraviolet radiation therapy.

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